THE MIDLAND NATURALIST:

THE JOURNAL OF THE
"MIDLAND UNION OF NATURAL HISTORY SOCIETIES,"
WITH WHICH IS INCORPORATED THE ENTIRE
TRANSACTIONS OF THE BIRMINGHAM NATURAL
HISTORY AND MICROSCOPICAL SOCIETY.

EDITED BY

E. W. BADGER & W. HILLHOUSE, M.A., F.L.S.

"Come forth into the light of things,
Let Nature be your teacher."
Wordsworth.

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PREFACE.

Once a year the appearance of Title Page and Index enables the editors of the "Midland Naturalist" to temporarily establish personal relations with its contributors, subscribers, and readers. A great many people—how many the list of contributors only partially shows—share in the labour of laying its monthly numbers before the public, and amongst these the editors are far from the most hardly worked. It is meet, then, that we should, as most gratefully and willingly we do, express our own indebtedness, as well as that of the general body of readers, for the hearty assistance without which it would be impossible to maintain the issue of our monthly numbers. Both to old and tried fellow-workers, who have stood by us from the beginning, and to the recruits who year by year are added to our ranks, we desire to offer this expression of our gratitude, and, we may add, also of our hopes.

But though the labour of producing the "Midland Naturalist" is shared by many, the responsibility is borne by the editors alone, and how anxious this responsibility is few of our readers can know. A Magazine which has completed ten years of active useful life ought to be out of the reach of accident, and the only care weighing upon its conductors ought to be that of properly editing the materials at their disposal. This is, however, very far from being the case, and it is fully within the power of our readers to relieve us of the more anxious part of our responsibility. Contributors and subscribers alike are needed. We are quite sure that our pages could be made far more interesting and far more valuable, but we cannot do it ourselves. We are not ubiquitous; we should only be a nuisance if we were; but in the Midland district, at any rate, our readers are well-nigh everywhere, and it is not unfair to ask them to try to repay the pleasure they receive from the observations of others, by contributing their own observations to enhance other people's pleasure, and to broaden the general knowledge. Every accurate observer is a potential public benefactor.

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THE MIDLAND NATURALIST.

"Come forth into the light of things,
Let Nature be your teacher."
Wordsworth.

PRESIDENT'S ADDRESS.*

BY R. W. CHASE.

Last year, when you conferred upon me the honour of electing me President of your Society, I undertook the office with considerable diffidence and misgiving, feeling that I was not competent to satisfactorily carry on the various duties of that position; but through the assistance and consideration shown me, not only by my colleagues on committee, but also by every member with whom I have been brought in contact, I have been able to get through my year of office, and I now take the opportunity of thanking one and all for their kind courtesy, as without it I should not have been able to fulfil my duties either to the advantage of our society—which we all desire to do—or with comfort and pleasure to myself.

Consequent upon being President, I have made the acquaintance of many members, and I hope I may say the friendship of not a few, which I trust may be further cemented in years to come, and if for this reason alone, I shall always look back upon my official year with pleasure.

Before entering upon the special subject I have chosen for my address to you this evening, I should like to mention one or two matters connected with our society which have occurred during the year. You will see from the annual report that the work of the society has been carried on as usual, details of which are set out fully in that report, therefore it is unnecessary for me to make any comments.

One subject I wish to draw your attention to is connected with our soirées, which, on account of the Midland Union of Natural History Societies meeting in Birmingham last year, was held in the summer instead of winter in conjunction with that meeting, and would have been successful in every way if the attendance had been larger. The falling off is

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* Transactions of the Birmingham Natural History and Microscopical Society.

to be deplored, as it evidently shows a lack of interest by the general public in the study of Natural Science. The meagre attendance was still more remarkable when we consider the fact that all members of this society had tickets forwarded to them, the cost of the same being covered by the annual subscription. The method of resuscitating the interest in Natural History must be by making our meetings more popular and attractive to the majority of members. I hope some plan will be devised whereby this can be attained.

The innovation of continuing the soirée on a second evening, when all the teachers of the elementary schools in the immediate neighbourhood were invited, was so eminently satisfactory that I hope to see the same arrangement adopted in the future. When I considered the fact that we had over one thousand visitors—all of them engaged in teaching—to view the various objects arranged for their inspection in the Town Hall, and when I heard the universal expressions of pleasure and delight, and beheld the considerable interest displayed by many in what they saw, I felt that the small additional expense entailed upon the society was both wisely and profitably incurred.

I think we may take it for granted that out of so large a number some will carry away with them the desire for a more intimate knowledge of some of the wonders and mysteries of Creation, and perhaps the cursory inspection of that evening may be the means of causing many to take up Natural History as a study, so providing both healthful and intellectual employment for their leisure. But apart from Natural History pure and simple, the art student might with advantage study some of the beautiful forms as displayed by the microscope; take, for instance, some of the desmids, diatoms, etc., etc. What more beautiful forms can man's device construct? If our workmen would only take natural objects for their models, how much more pleasing and artistic, in my mind, would their work be than the grotesque and unnatural monsters they often turn out, as much like what they are intended to represent as, let me say, the manipulator himself. Only the other day an entomological friend told me that he often lent specimens from his cabinet for jewellers to work from, and that the results were so superior that the same course might be adopted in many other crafts. Some time ago I looked at a costly set of china plates painted to represent our various native birds, the majority of which were simply abortions of what was intended to be illustrated; the artist had evidently wasted his time by copying badly stuffed specimens in some museum.

I venture to think that considerable advantage would accrue to many if they were to join some Natural History Society and obtain an opportunity of peeping into "the book of Nature."

At the meeting of the Midland Union a strong appeal was made for the protection of native plants, which I hope has met with some success. I now wish to raise my voice on behalf of the feathered tribes, my especial favourites, who, to satisfy the demands of a certain fashion, are being slaughtered all over the world, to decorate both hats and dresses of fashionable ladies. Criticising such decorations from a naturalist's point of view, they are neither beautiful nor real; you often see the wings of one bird associated with the head and tail of another, or *vice versâ*, and arranged contrary to all natural laws. This slaughter is no light matter, when skins are ordered by the thousand and tens of thousands, if we wish to preserve from total extinction a number of birds, many of them the brightest gems in creation. The formation of the Anti-Plumage League has not been started too soon, and every Natural History Society ought—in fact it is a duty—to assist as far as possible in putting an end to this "barbaric fashion." If the fair wearers would only consider for a moment the cruelty and suffering caused in obtaining the necessary skins to trim even one dress, I feel sure their kind feelings and tender hearts would cause them to shun such a fashion. You may say that I am the last person qualified to advocate the preservation of birds, having so many victims in my possession, but I do not hesitate to say that one milliner's warehouse would contain more skins than all my collection. If the Press would only take this matter up in the same spirit they do if a single rare migrant is shot, which in all probability would not stay in this country, I fancy the slaughter of the "innocents" would soon come to an end.

The subject I have chosen for my address is not only interesting to an ornithologist, but to naturalists in general, especially to evolutionists, viz., "The coloration of eggs and form of nest: whether governed by inherent instinct or not."

It has been affirmed that birds construct their nests not from instinct, or, more properly speaking, inherent knowledge how to form their nests, but from imitation and memory, and statements in support of such theory are given, such as this—that birds in confinement do not make a nest typical of their species. Perhaps not, because in all probability the bird has not the proper materials wherewith to construct one; but surely even a cage bird must have been hatched in one, and therefore, according to the argument, ought to have built one after the pattern of the only one it had ever seen.

Let us consider for one moment what opportunity a bird has for learning the art of nest building. In the first place, the nest is constructed before the eggs are laid, consequently the young when hatched can have had no opportunity to see the operation of building, neither can they have had pointed out to them the proper and most likely places where to obtain suitable materials. Again, the principal characteristic of nests is the manner of construction, and with the same materials—moss, lichen, and hair—two distinct species will produce quite a different edifice. Therefore, when we consider that the young are often only in the nest from fourteen to twenty-one days, is it to be believed that they can possibly in that short time learn the art of nest building simply from examination of their home during their occupation, and that the details are so impressed upon their memory; in fact, that the young ones have learnt their lessons so well as never to forget it? I think certainly not. To suppose birds build their nests from imitation and memory seems to me to at once allow them the power of reason, which I am certainly unwilling to grant, although I know it is a very debatable point where instinct ends and reason begins, the two being divided by such fine and delicate distinctions that it is difficult to define a hard and fast boundary to either. Again, how can the young birds know what bird produces the feathers that line the nest they are in? Surely when the time arrives for them to build they do not hunt about until they find a facsimile to those in their old home, nor are the architectural details so vividly impressed upon their memory that after often a period of months and in some cases years they are able to construct a counterpart. I have no hesitation in saying that supposing you were to exchange the eggs from the nest of a robin and place them in that of a hedge-sparrow, that the young robins would, when the time came for them to construct a nest, make one after the type of their real, instead of that of their foster parents.

Or if you exchange eggs with a blackbird and thrush, I am certain, although the thrushes were reared in the blackbird's nest, they would in their own nests use the characteristic lining of their species, and would not use the only nest they were acquainted with as a model.

In support of the imitation theory it is urged that the young birds have "an opportunity of examining old nests," and also seeing some constructed prior to the time of their own nidification; this would hardly apply to those species that do not arrive at maturity before three years, as generally they do not associate with the adult breeding birds, but congregate together in flocks, away from the nesting stations. If this imitation tendency is so powerful, how is it that the kestrel has never developed nest building, although Nature has endowed her with the same means or tools in the way of beak and claws as the sparrow hawk? but instead of constructing a nest of her own she makes use of an old or deserted one of a crow. The young kestrels, while in the nest, cannot possibly know the nest was not constructed by their parents, therefore this propensity of using another's nest must surely be put down to inherent instinct. Some no doubt will say that an ancient pair of kestrels, more advanced in wisdom than their fellows, adopted the plan of utilising deserted nests in years gone by, and that their descendants follow their example at the present time; but how would it be possible for the original wise pair to impart their knowledge to their offspring?

Again, why should not the cuckoo develop a propensity to construct a nest similar to that in which it was reared? I say, simply because it would be contrary to its inherent instinct. But it is argued that supposing a young cuckoo is brought up in a wagtail's nest, that individual would in the future look out for a wagtail's nest to deposit her eggs in likewise; but supposing the young cuckoo proved a male—I believe males largely preponderate—the desire to use a nest of the same species must end in this case, as the male cuckoo takes no part whatever in domestic duties; the transmitting of this trait must, therefore, rest entirely with the female bird. The consequence of this would be to very much restrict the number of species whose nests are used by the cuckoo, whereas the contrary is the case, as each year fresh species are added to the list in which a cuckoo's egg has been found.

If this imitation theory is correct, how are we to account for a cuckoo's egg being found in the nest of Podiceps minor? such find being on record; because it would be an impossibility for a cuckoo to be reared by such foster parents. Whence, then, had the parent cuckoo her desire to deposit her egg in such an unsuitable nest?

It has always been a mystery to me how the cuckoo is able to ascertain if incubation has proceeded in the eggs of the bird she wishes to use as a foster parent for her progeny, because I have generally found that the legitimate eggs as well as the alien one hatch almost simultaneously. Various explanations have been given; one is that the cuckoo destroys one of the eggs in the nest before depositing her own to ascertain if the clutch is fresh. I think this is probable, as I have often found egg shells in proximity to a nest containing a cuckoo's egg, evidently destroyed by some bird. Another explanation is that the cuckoo watches the nest being built, and as soon as the first (one or two) eggs are laid then deposits her own, as after incubation had commenced she would have little opportunity of effecting her purpose, the intended foster parent being rarely absent from the nest. The belief held by many, that the cuckoo is able to produce an egg closely resembling those in the nest she contemplates making use of, is so illogical that if it were not for the wonderful similarity in colouring often observable between the cuckoo's egg and those belonging to the nest, it would soon die out; but quite as great contrast is also found. If the cuckoo had this power of discriminating colour, it is certain that after laying the egg and ascertaining the peculiar tints she would have to carry it about either in mouth or feet until she found a clutch of analogous hue.

Now, when we consider that the cuckoo cannot know the colour of her egg until it is extruded, supposing one lays an egg very like a meadow pipit's and deposits such egg in a nest of that species, it is very likely that in that same neighbourhood several instances will be found of this close resemblance, which is easily accounted for, as the cuckoo lays about four or five eggs, if not more, in the season; and I also have no doubt that all laid by the same bird are alike in colouring, and in case pipits' nests were plentiful, I see no reason why the cuckoo should wish to exert herself in finding others; hence we should get a number of examples of this close similarity of colouring.

I will give you an instance that came under my notice which clearly proves that a bird lays eggs always alike in colour and markings. Two years ago my father showed me a clutch of blackbirds' eggs in a spinney near his house, of unusual coloration, having all the markings collected in a band or zone at the larger end, instead of being speckled all over. I took these eggs, but, unfortunately, they were hard set, therefore did not make good specimens for the cabinet; about three weeks later, I was informed that the same pair of birds had nested again, and upon putting the old bird off her nest, I found a clutch of eggs exactly like those I had previously taken.

(To be continued.)

AN EXCURSION TO TENBY.*

June 5th to 19th, 1886.

BY W. P. MARSHALL, M.I.C.E.

This was a fortnight's excursion made by a party of Members of the Natural History and Microscopical Society in June last; there were eighteen in the party, fourteen of whom stayed the whole fortnight. An entire house was taken for the party, "Worcester House," on the Esplanade, Tenby; very conveniently and pleasantly situated, and well suited for our purposes, with a handy work-room on the ground floor for marine collections and microscopical work. The rocky cliff in front was covered with flowers, especially fine masses of Viper's Bugloss and red and white Valerian.

At the foot of the cliff is an extensive sandy beach, which is covered at high water, but at low water gives access to St. Catherine's Rock in front; a rock that is perforated with sea caves, in which are numerous rock pools, that afford a fine supply of marine objects.

The coast for a long distance from Tenby is a very irregular line of bold, rough cliffs, worn by the sea action, which is very severe at times, the coast being exposed to the force of the Atlantic waves; and the rocks are hollowed out into caves and natural archways, with detached isolated rocks standing out in the sea. These caves, where accessible at low water, contain an extensive and fascinating collection of marine life.

Excursions were made to many specially interesting and pleasing spots; particularly numerous fine specimens of ruined castles and ivy-covered church towers.

The following land excursions were made by the party:—

Monkstone Bay, two miles, where numerous rock pools were found at low water. The rocks showed a very interesting example of contorted and dome-shaped strata.

Carew Castle, six miles, a picturesque ivy-covered ruin on the edge of one of the long inlets from Milford Haven, which runs in to a distance of fifteen miles from the sea.

Lamphey Palace, eight miles, and Pembroke Castle, ten miles from Tenby, finely situated on another inlet of Milford Haven. Pembroke Castle is a remarkably good example of an ancient castle, and has a fine large keep in good preservation, which forms a conspicuous and picturesque object

* Transactions of the Birmingham Natural History and Microscopical Society, read October 12th, 1886.

for a wide distance round. Several successful photographs of the castle were taken by one of the party, Mr. Potts, who was very active in photographing the various objects of interest met with in the excursions, and took more than forty photographs.

Manorbere Castle, five miles from Tenby, is picturesquely situated on the southern coast, and affords a particularly good example of an ancient baronial residence; it is in good preservation, and a portion is now occupied as a summer residence by a gentleman's family.

Lydstep Caves, four miles from Tenby, are a special locality for marine specimens; the best portions are only accessible at low tides, and abound in well-stocked rock pools. The rocks are very bold, and present a striking appearance from the beach at low water, with their caves and natural arches. Amongst the marine objects found there was *Tubularia indivisa*, a lovely rose-coloured polype, growing in a small sheltered hollow of the rock.

Stack Rocks was a long excursion, sixteen miles from Tenby, where two detached pinnacles of rock, 300 feet in height, stand out in the sea. These isolated rocks are the special resort of enormous numbers of birds, which have bred there annually from time immemorial; and they completely cover the whole of the top of the rocks, and the ledges on the face. The birds are chiefly Guillemots, called locally "Elegugs," and are conspicuous from their white breasts, and they present a striking appearance of large white patches on the rocks, and long white lines on the ledges of the rocks.

One sea excursion was made in a steamer from Tenby along the south coast, round Linney Head, and up Milford Haven to Pembroke; a very striking and beautiful view was obtained of the bold rocks along the coast, and particularly of the Stack Rocks, the steamer passing very near to the rocks, as the weather was fortunately suitable. While passing, a gun was fired, and an extraordinary mass of birds rose up suddenly into the air, leaving the rocks black where they were before white.

It is only during the period of rearing their young that the Guillemots frequent the ledges and crevices of the precipitous sea cliffs, appearing about April and leaving in August; performing a partial migration, as after the young are full grown they forsake the breeding stations and keep some distance out to sea, and until the following spring only occasional birds are seen in shore. The number of these birds congregated together at the breeding stations is astonishing; the ledges or shelves of the cliffs are simply packed close with the birds, and most comical they look in their upright position side by side, forming long rows upon the narrow ledges, which are often only a few inches wide, the birds appearing like white lines drawn upon the face of the cliff. Such a breeding station is a busy scene, and one not easily forgotten; thousands of birds continually on the move, flying down from rock to sea, and up again from sea to rock, whilst thousands are busy in the water after their finny prey.

The Guillemot lays one egg only, of enormous size in comparison to the bird, upon the bare rock; the eggs vary infinitely both in colour and markings, it being almost impossible to obtain two eggs alike, unless laid by the same bird. There are other similar breeding stations, at Lundy Island, in the Bristol Channel; Flamborough and Bempton Cliffs, Yorkshire; Farne Islands, Northumberland; the Bass Rock, Frith of Forth; the Hebrides; and the Orkney and Shetland Isles. The information about these birds has been kindly supplied by our president, Mr. Chase.

Amongst the plants collected in the excursions were specially noticed fine large specimens of Columbine, *Aquilegia vulgaris*, in the hedges near the sea; *Orchis latifolia*, the smaller Butterfly Orchis, at Monkstone Bay; the little Burnet Rose, *Rosa pimpinellifolia*, abundant on the sandhills close to Tenby; *Echium vulgare*, Viper's Bugloss; and *Centranthus ruber*, the red Valerian, on the rocks at Tenby. Also amongst ferns, *Asplenium marinum*, *Asplenium adiantum-nigrum*, and *Ceterach officinarum*.

Dredging was only tried one day in Milford Haven at Pwllcroghan, using the small-sized dredge from a sailing boat. The water was shallow and the bottom muddy, and satisfactory results were not obtained.

The special collecting that was done in this excursion was with a surface tow-net, using a new construction of net, which we tried then for the first time. It was designed by Mr. Giles, of Madras, and was described by him in "Science Gossip" for March last (page 52), and it appeared to us so good an idea that we determined to make trial of it upon the first opportunity. In the ordinary tow-net, with a glass bottle attached to the tail end, the bottle is filled at once with water that has passed through the net containing objects in it; but the further supply of objects into the bottle can only be obtained by their chance passage from the bottom of the net into the bottle, as no more water can enter the bottle after it is once filled except by the chance displacement of some of the water to make room for more.

In the new tow-net, instead of a bottle an open glass tube is attached to the tail end of the net, through which the water flows, and the outer extremity of the glass tube is expanded to a wide mouth, three inches diameter, across which a fine muslin strainer is fixed. This allows a constant current of water to pass through the glass tube whilst the net is towed along, carrying with it the minute organisms that are floating in the water; but whilst the water passes through freely, these organisms are all retained in the glass by the fine muslin strainer. The net used was a strong, coarse muslin funnel 3½ft. in length and 1½ft. in diameter at the mouth, which was kept open by a light brass hoop to which the towing cord was attached. An inner shorter funnel 1½ft. in length was attached to the same mouth ring, ending in an opening about six inches diameter; this inner funnel serves as a trap to check the escape from the net of any objects that enter it. After towing the net at a very slow speed for about ten to fifteen minutes it was drawn up, and the glass plunged at once into a basin of water to prevent the water sinking down in the glass so low as to risk damage to the contained objects by their getting too closely packed. The net was then untied from the glass, and the contents of the glass poured out for examination. Some minor modifications were made in the apparatus in the course of the trials, such as dispensing with a cork float originally fitted upon the glass tube, and some further minor improvements may probably be made as the results of experience, but the plan proved a thorough success and very efficient in working.

The tow-net collecting was mainly in Tenby Bay, near St. Catherine's Rock, from a rowing boat, and quantities were obtained there of *Noctiluca miliaris*, the minute globular organism that is the most usual cause of phosphorescence of the sea; and this phosphorescence was brilliantly shown after the specimens were taken ashore, and even remained visible in some after bringing them to Birmingham.

Quantities were also obtained of the medusiform gonozoids of *Obelia dichotoma*, which are the minute free swimming larval state of a polype that in its mature state is stationary in a fixed branched form; these formed very beautiful objects for the microscope when in the living state, actively moving by the flapping pulsation of the medusa umbrella. The delicate and beautiful *Cydippe pileus*, or Sea-acorn, was also found in abundance.

The larger Medusæ, or Jelly-fish, were also caught in the tow-net, and sometimes caused trouble by choking up the entrance to the glass tube; and to prevent this, the addition of a light wire sieve of about an inch mesh is desirable at the mouth of the net.

On the shore of St. Catherine's Rock a fine specimen of a large Jelly-fish, *Rhizostoma Cuvieri*, was caught entangled in the sea-weed; the bell measured seventeen inches diameter and eight inches height, and it was composed of a thick, tough, cartilaginous substance of an opaque white.

Many beautiful specimens of Sea Anemones were found upon the rocks, but they were difficult to remove in most cases, on account of shrinking back into holes in the honey-combed surface of the rocks. Under the overhanging rocks that were uncovered at low water, large numbers were seen hanging as long jelly-like pendants from the holes and crevices. The common *Actinia mesembryanthemum* was very plentiful, of great variety of colour; a few of a very beautiful green, and one or two bright scarlet. *Sagartia venusta*, the orange-disc anemone, was in great numbers, but in very inaccessible places; *Sagartia nivea*, the snow anemone, not so plentiful, and very difficult to get at, as they generally lay so deep in the crevices of the rocks; *Dianthus plumosus*, very plentiful; *Telea crassicornis*, only a few. These particulars of the Sea Anemones have been kindly supplied by Mrs. Rabone.

Specimens of Serpula and Spio brought away upon pieces of stone and placed in a small aquarium glass, formed very interesting and beautiful objects for examination with the microscope, in a living state, and feeding upon small crumbs dropped into the water; numbers of the larva of Spio recently escaped were also seen floating about.

In water holes in St. Catherine's Rock there was found the branched polype, *Plumularia pinnata*, and a special piece of microscope work that was done was the mounting of specimens of *Plumularia* with the tentacles remaining expanded. This was effected by the plan of one of the members, Mr. Clarke; he administered minute doses of gin and sugar to the polypes at short intervals, until after about a quarter of an hour or longer they were found to be dead with their tentacles well expanded.

Trials were made of different media for mounting, and on the whole *Hainsch's fluid* (consisting mainly of glycerine and alcohol) was found the most favourable for preserving delicate objects, such as the medusiform gonozoids; but further trials and longer experience are required respecting this point.

We were also specially indebted to Mr. Bolton for his efficient aid in collecting and preserving specimens, and exhibiting microscopic objects in the living state.

We had the pleasure of the company on several occasions of Mr. F. Walker, of Tenby, an enthusiastic naturalist, who has for many years closely studied the fauna and flora of that district, and who afforded us valuable information and assistance.

In conclusion, it has to be added that for the organisation and effective carrying out of this delightful and instructive excursion we were entirely indebted to our esteemed friend Mr. Morley, to whom our best thanks are due.

LIONS BRED IN CONFINEMENT.

It will probably astonish many to learn that in the gardens of the Royal Zoological Society of Ireland, Phœnix Park, Dublin, within the last thirty years, no less than 131 lion cubs have been born. The breeding stock was started by a pair of African lions imported from Natal in 1855. The first litter was born in 1857, and between that date and 1885, of the 131 produced, twenty-one only were lost, and they were either born dead or died shortly after birth; and of the 110 reared, eighty-six were sold, so that zoological gardens, not only in Europe, but also in America and even Africa, have been supplied with lions born at Dublin.

The first lion, Natal, lived in the gardens for eight years; his progeny by three different lionesses amounted to forty-two. The second lion, Old Charley, a son of the above, was the father of forty-six cubs; he died at the age of ten years. His son, Young Charley, died when twelve years old, having had twenty-seven cubs, one of whom, Paddy, is at present in the gardens, and is now rising seven years old. Seven lionesses were bred from in the gardens, the most remarkable being Old Girl, the offspring of the first pair. She was mated when two and a half years old, and was the mother of fifty-five cubs in eleven years, forty-one of which were disposed of, realising no less a sum than £1,400 for the society. Old Girl died at the age of sixteen years, having become very feeble and diseased. The number of cubs in each litter varied from one to eight, but the general number was four. The period of gestation is fifteen weeks.

Of the 131 cubs produced, the sex of one born dead was not recorded; the remaining 130 were seventy-four males and fifty-six females. The cubs at birth were distinctly spotted with dark brown on a light brown ground; these spots generally disappear, but are sometimes to be found on the lower parts of the adult animals, especially of the lionesses. The spots were never arranged in bands, as sometimes stated.

Those who may wish for further particulars will do well to refer to an exhaustive article on the subject in the "Transactions of the Royal Irish Academy," Vol. XXVIII., Part 24, Aug., 1886, entitled—"Observations on Lion Breeding in the Gardens of the Royal Zoological Society of Ireland," by V. Ball, M.A., F.R.S., Director of the Science and Art Museum, Dublin, and Hon. Sec. of the Royal Zoological Society of Ireland.

A VISIT TO CHIRK.

On Easter Monday last, April 26th, about fifty members of the Birmingham Natural History and Microscopical Society and their friends made their first excursion of the season to the interesting village of Chirk. Among those present were the Rev. H. Bonner, Messrs. W. P. Marshall, M.I.C.E., W. B. Grove, B.A., J. Potts, J. H. Wright, J. Rabone, W. H. France, W. B. Malins, W. Phillips (Shrewsbury), J. Morley (Hon. Sec.), and others, including many ladies.

Proceeding by the 8.32 Birkenhead express train, they reached Chirk Station at 10.45. The rendezvous was the Chirk Castle Arms, or, as it is popularly called, the Hand Hotel. Some years ago it was known as the Red Hand, and a large signboard bore a representation of an open red hand. It was so called from the circumstance of the red hand being the crest of the Biddulph family, who are the owners of Chirk Castle, and of large estates in the county. The only representation of the old "red hand" now to be seen at the hotel is a small bright golden hand displayed in the lamp over the door. The Hand is a favourite public-house sign in Montgomeryshire and Denbighshire, as, for example, the "Hand" at Llangollen and other places. The open red hand, which forms part of the arms of the Province of Ulster, commemorates the daring of a bold adventurer, one O'Neile, who made a vow to be the first to touch the shores of Ireland, but finding the boat in which he rowed outstripped by others, he cut off his hand and flung it ashore, to touch it before the others could make a landing. The open red hand in the armorial coats of some baronets, as in the case of Sir Thomas Holte, of Aston Hall, which may be seen in a window in Aston Church, thus originated. Two hundred baronets were created by James I. on payment of £1,000 each, ostensibly for the relief of Ulster, but really for his personal aggrandisement, and they were therefore allowed to place upon their coats of arms the open red hand, or the "bloody hand," borne by the O'Neiles, whose estates had been seized by the King. They were called "Ulster baronets." The "bloody hand" was often, in the popular mind, associated with some deed of blood, supposed to have been perpetrated by the individual in whose arms it was placed. Thus, Sir Thomas Holte was said to have murdered his cook some 250 years ago, and when pardoned by King James was ordered to bear a "bloody hand" ever afterwards on his coat of arms, when the sole reason was, as we have shown, that he had paid into the King's exchequer a thousand pounds for a mere title.

On leaving the railway a pleasant walk of an hour was taken by the excursionists into the valley of the Ceiriog, to view the aqueduct and viaduct which cross that river. The aqueduct which carries the Ellesmere Canal was designed by Telford; it is 690 feet long, and 65 feet above the river; the viaduct is 100 feet above the bottom of the valley. The view was especially fine, and the botanists of the party found abundant occupation in their favourite pursuit. The church was next inspected. It is an ancient structure, but calls for no especial remark, as it was some years ago restored, at an expense of upwards of £2,000. It contains some monuments and stiff effigies of the Myddelton family. The oak roof over the older part of the church is in good preservation. Tradition has it that Dr. Sacheverell was once rector of this church, from which he was suspended for three years, and two objectionable sermons preached in it by him were burned by the common hangman. This, however, is a mistake, as it was a neighbouring parish over which he presided. The aged yews in the churchyard are particularly fine, and well accord with the solemnity of the place.

After a substantial luncheon at the hotel, a walk of some two miles or so through pretty and diversified scenery brought the visitors to the castle. Chirk Castle is a quaint structure, partaking of the features of both castle and mansion, with the angles strengthened by four exceedingly clumsy bastion-like towers, each of which is surmounted by a small turret. The present structure was built by Edward I., though a castle had stood upon the same site two centuries earlier. It was in 1595 the property of Sir Thomas Myddelton, who afterwards became Lord Mayor of London, and was the brother of the celebrated Hugh Myddelton, the projector of the New River from Hertfordshire to London to supply the metropolis with water. The estates have continued in the same family to the present day, although the name of the owner has become changed from Myddelton to Biddulph. In the time of Charles I. Sir Thomas Myddelton declared himself against the Royal cause, and achieved several brilliant exploits, although he did not take the field till he was near sixty years of age. His estates were sequestered, but he afterwards obtained repossession of his patrimony at Chirk. A year before the Restoration, however, he had changed his views, and had precipitately declared in favour of the second Charles's return. For this his Castle of Chirk was besieged and taken, the trees in the park were cut down, the timber sold, and damage was done to the extent of £80,000.

Entering by the gateway tower, the visitor passes into a large quadrangle, which has evidently undergone much modern restoration. These alterations, with considerable internal embellishment, were the work of the elder Pugin. The great hall contains a vast number of ancient implements of war, and others for domestic use, including several fine black-jacks, tall hats of the Cromwellian period, &c. A curious bird's-eye view of the castle in the seventeenth century was shown; it is made of mosaic, the several minute pieces of which it is composed being of ivory and bone inlaid into a black oak background. It was made about forty years ago from the handles of old tooth-brushes and other articles of bone or ivory. It is inscribed in the same material, "Chirk Castle, Denbighshire, the seat of John Myddelton, Esq.; done by the porter, Roberts." The frame is of the same material, and altogether the work is ingenious and very effective. To describe all the beauties and rarities contained in this interesting building would much exceed the space at our disposal. The rooms are of grand size and proportions, and the ceilings and walls throughout are adorned with arabesques and gilding in profuse extent. The walls of the various rooms contain many paintings, chiefly portraits. There are portraits of the great Duke of Ormond; Charles II.; Barbara Villiers, Duchess of Cleveland; the Duke of Monmouth; Fair Rosamond; Queen Mary; Jane Shore; Sir Thomas More, by Holbein; the Countess of Warwick, afterwards the wife of Addison; Sir Orlando Bridgeman, in his robes, and Lady Bridgeman; and many other historical portraits. Landscapes and other artistic works are not wanting to give variety and grace to the collection. Several landscapes by Wilson, the father of the English landscape school, as he is called, attracted especial attention. A curious painting of Orpheus charming the brutes was particularly droll. One of the chief of his charmed listeners was a full-grown unicorn, which would not have disgraced any Royal arms with which he might have been connected, while the lion had a singularly human face, with an aquiline nose. Most of the furniture of the show rooms of the castle was very fine, and in good condition. In one of the rooms was a magnificent cabinet or *prie-Dieu*, presented by Charles II. to Sir Robert Myddelton. At the Restoration the King offered him a peerage, which he declined, upon which the King said, "Then take this cabinet home with you as a memorial of my regard." The cabinet is made of ebony, and contains twenty-five or thirty panels, in every one of which is an exquisite painting by Rubens. They are upon copper. Those on the outside are classical, while those within are scriptural subjects. On a large flap inside, about twenty inches by ten, is an exquisitely painted representation of Christ blessing little children, which contains many figures. The interior of the cabinet has many drawers, and is veneered throughout with tortoiseshell and choice woods. The frames and fittings of the pictures are all of richly chased silver, and it is estimated to be of the value of at least £10,000. Charles I. slept in the castle in the year 1645, and the bedroom he occupied was shown, but the bed was not as it was then in use.

The painting which was the object of the greatest curiosity is a landscape and a marine view combined. It was painted by a foreign artist, who was commissioned to paint the Waterfall of Pistyll Rhaiadr, in Montgomeryshire. The Myddelton for whom it was painted suggested that the introduction of some sheep would materially improve the picture, but in his Welsh pronunciation he said he wanted some *sheeps* in it. The artist accordingly altered the picture, and made the water as falling into the sea, on which he painted some *ships* lying at anchor close to the rocks. Now, considering that the Pistyll Rhaiadr is more than thirty miles from the sea in any direct line, the picture is as curious an anomaly as was ever perpetrated on canvas. A descent into the dungeon was made by most of the visitors. It was a gloomy chamber about thirty feet below the surface, the only air or light obtainable being through an aperture a few inches square at the top of a shaft in one of the walls of the room. A more horrid place for a human being to exist in can scarcely be conceived. Watt's dyke passes through the castle grounds, and Offa's dyke at a mile distant, but time did not permit of a visit to either, though they had been included in the programme. Offa's dyke, which extended from the Dee to the Wye, is here to be seen in as almost perfect a state as when it was constructed by him in the eighth century to defend his country, Mercia, from the incursions of the Welsh.

After the visit to the castle a return was made to the hotel, where tea was served, and the party arrived in Birmingham at half-past seven. The comfort of the party was greatly enhanced by the courtesy of Mr. Paxton, of the Great Western Railway, who provided saloon accommodation, and in other ways made special arrangements to promote their convenience. The conduct and arrangement of the excursion was made by Mr. J. Morley, the honorary secretary.

THE PRINCIPLES OF BIOLOGY.*

BY HERBERT SPENCER.

Exposition of Part IV., Chapters VI. to XII.

"The Morphological Composition of Plants."

BY W. HILLHOUSE, M.A., F.L.S.

[Abstract concluded.]

Spherical symmetry is rare in aggregates of the second order, but a case is met with in *Volvox*. No doubt the comparatively perfect symmetry of this plant is due to its being free and motile, so that the distribution of forces can be equalised. Most of these higher organisms are fixed, and spherical symmetry becomes necessarily lost; a tendency to it is, however, shown amongst Florideans, while *Fucus* shows bilaterality or asymmetry. It must be borne in mind that in large developments perfect and absolute equality of part is an impossibility; hence many organisms which, like the mycelium of *Mucor*, Mr. Spencer tends to consider asymmetrical, may be just as symmetrical as, from a finer point of view, *Protococcus* is. Thus to the naked eye view the cap of an ordinary Agaric is radially symmetrical, but if you insist on mathematical accuracy, probably radial, or any other, symmetry does not exist. All these aggregates of the first and second orders the botanist speaks of as morphologically undifferentiated into members; *i.e.*, as constituting a *thallus*.

* Birmingham Natural History and Microscopical Society, Sociological Section, Dec. 17th, 1885, and Jan. 21st, 1886.

The aggregates of the third order are with very few exceptions fixed, and even in those exceptions (*Lemna*) show distinct bilaterality, or dorsi-ventrality. In uniaxial plants, the bird's eye type is radial symmetry, *e.g.*, a Palm. Divergences, where met with, affect usually the flower only, *e.g.*, Foxglove, Wild Hyacinth. In multiaxial plants the general type again is radial, but constantly broken, even in the open, by inequality of sun's rays, and the prevalent direction of the wind. The type of the root is more distinctly radial, in cases, indeed, we might almost describe it as hemispherical, but divergences arise from inequalities in the hardness of the soil, and in the distribution of moisture, and of internal food supply.

The nearest approach to simple spherical symmetry in branches is in the "buds" of the yeast plant, and the conidia of many fungi. The most of simpler plants have their branches radial in type, and often radial in development, and in these, as in all cases, the branch is either a repetition or a simplification of the axis, and the attached differs strongly from the free end. Florideæ, Characeæ, and Equisetaceæ furnish abundant illustrations. Of the larger plants, many do not branch at all; those which do produce their branches originally in radial wise, though by stress of circumstances they may ultimately become strongly bilateral, *e.g.*, the Lime and the Fir; the two main agents in this change are light and gravity. The influence of the action of light is very strongly manifest in such a case as the Ivy; where growing out free above a small tree which it has enveloped, it seems hardly the same plant as when clinging to the face of a wall.

In leaves, highly differentiated as they are, spherical symmetry is entirely wanting, and even radial (peltate) symmetry is rare. This latter is met with in certain cases, such as *Oxalis* and *Marsilia*, amongst compound leaves, and *Nelumbium*, *Tropæolum*, *Victoria regia*, and *Hydrocotyle*, amongst simple leaves. In all these cases we have either vertical leaf-stalks, from a more or less creeping stem, or else leaf-stalks so long that they can carry out the laminæ to a considerable distance from the centre. Interesting transitions are furnished by such a plant as the Lupine, in which the radical leaves show proximate radial symmetry, but with the external leaflets longest while the cauline (stem) leaves successively become more strongly bilateral. The influence of light is here probably the most important factor, each leaf, or leaflet, tending to grow uncovered by the shade of its next successor. An illustration of this is provided by two semi-aquatics of generally like habit; in the Water-cress, with the shade near the stem, the terminal leaflet is largest, in *Helosciadium*, with less shading, the proximal leaflets are largest. This is evidently quite akin to the varying thickness of leaves on one and the same tree, according to whether they are growing on the outside, exposed to full sun-light, or in the interior in comparative shade. In the beech, for example, the former can be as much as three times the thickness of the latter.

Before quitting this subject of leaves, we ought, while clearly acknowledging that they furnish many of the most beautiful illustrations of relations to external forces, nevertheless to draw attention to the manifold dangers of inductive biology founded upon such variable members as leaves are. In many cases their forms may be due, not to present, but to ancestral conditions of life, and the plant may not be equiplastic in morphology and in physiology. Thus, while we acknowledge that radial (peltate) leaves have erect leaf-stalks, and are, in general, radial, it is not true that radial leaves tend to be peltate. The great majority of erect growing leaves are sword-shaped or grass-like.

The consideration of the evolution of flowers opens up a series of most interesting and important facts. Referable as floral parts are to the leaf-type, they have deviated as a rule widely from it, though the deviation of the bract of *Helleborus fœtidus* from the form of the radical leaves of the same plant is at least as great as the flower shows. The plasticity of the flower is about equivalent to that of the leaf. Floral branching, however, commonly differs widely from stem-branching, and the former may be present where the latter is not.

The fundamental arrangement of leaves is no doubt primitively spiral, and the primitive arrangement of floral parts followed the same type, and produced the cone. The radial, or cyclical, arrangement for leaves, excepting on a very restricted scale, is rare; the cyclical arrangement of floral parts is, for some part or other of the flower, well-nigh universal, at least in external appearance. The study of the organogenesis of the flower would suggest, however, that the cyclical state is an after state even in the individual flower, and that the parts, even when they are joined together, may be, in a limited sense, of different ages. But if equivalence comes about at all there is a tendency for it to be produced at progressively earlier periods, and hence fundamental spirals can ultimately give origin to true cyclism.

No doubt an erect growing flower would tend to be radial, but *Pinguicula* and *Viola*, both fundamentally erect-growing flowers, diverge widely from the radial type. Interesting examples of the kind of agency which may effect change are provided by the Candy tuft, the wild Guelder rose, and several Umbellifers, as well as by a large group of the Compositæ. In all these cases the flowers form a more or less flattened group, and while the central flowers are radial (as far as general contour goes), the external flowers are entirely bilateral, extending largely on their external side. Clearly here, as in the inverted flowers of Orchids, and the pendant raceme of the Laburnum, mechanical conditions, though of a different class, come into play. Again, the under half of a bilateral flower tends to project beyond the upper half. Whence is this? As Mr. Spencer points out, these parts contain no chlorophyll, and hence, he assumes—"the tendency to grow most where the supply of light is greatest is less decided, if not absent." But perhaps he has told here but half of the tale. The tendency of green parts to grow largest in the greatest light is strongly marked; but it is equally true that light has certain mechanical effects which are *disadvantageous* to growth, and that, therefore, in a part whose growth is independent of light, the growth, *cæteris paribus*, will be greatest where the light is least. Nor do I think the mechanical reasons referred to above must have undue weight attached to them. The most marked cases of bilaterality in flowers are those where insect agency is the medium for fertilisation, and the progressive influence of this agency upon the flower introduces a disturbing factor of the first class.

Another point of prime interest in an enquiry such as this can be only touched upon here, and it is this: that while in the flower as a whole the radial type greatly outnumbers the bilateral, in the ovary the bilateral type hugely preponderates. Excluding Leguminosæ and Euphorbiaceæ there is no natural order of primary numerical importance which has not a bicarpellary ovary.

As to the question of the shapes of vegetal cells, discussed by Mr. Spencer with great brevity in Chapter XI., space will not permit us to do more than indicate a few points of importance. Mr. Spencer's own conceptions are remarkably circumscribed. A point we should like to lay stress upon is the different shapes of cells in the interior tissues of the leaf. Taking a typical flatly exposed leaf, under its upper surface are one or more layers of cells whose long axis is vertical to the surface, and in the same leaf the number of these layers will vary with the exposure of the leaf. The more light, the more the layers. In plants of shady places, and in shaded leaves, they are either entirely or well-nigh wanting. They are manifestly intercepting cells. Over the under epidermis of the leaf the tissue hardly varies at all. It is a spongy parenchyma, with abundant air-spaces. In vertically growing leaves the layer of vertical cells ("palisade layer") may be present on both sides, or on neither. There is here, therefore, manifest relation of structure and light. Again, the elongation of fibres and of the elements of vessels is due, in part at least, to the stretching influence of actively growing cells in their neighbourhood, and the reality of this factor may be recognised by the elements sometimes being even torn asunder. As to the origin of the diversity of form of free-growing cells, and of the hairs on an epidermis, let us at once acknowledge our complete and absolute ignorance; and in conclusion point out that even in those cases where the matter appears to our finite knowledge to be perfectly clear, we are arguing in the absence of a general factor of vital importance—in the absence, viz., of any excepting the feeblest glimmerings of knowledge as to the historical conditions of life of the plant in question.

THE PRINCIPLES OF BIOLOGY.

The Sociological Section of the Birmingham Natural History and Microscopical Society completed their study of this work on Thursday, December 17th, 1886, when Dr. Alfred Hill, F.I.C., delivered an exceptionally able and interesting address on the final chapters of Part VI., LAWS OF MULTIPLICATION, viz., "Multiplication of the human race" and "Human population in the future." There was an unusually large attendance, and a discussion followed, in which the President (Mr. W. R. Hughes, F.L.S.), Mr. F. J. Cullis, Mr. R. W. Chase, Mr. W. H. France, Miss Dalton, and others took part. A hearty vote of thanks was passed to Dr. Hill on the conclusion of his address, which occupied upwards of two hours in delivery.

This important work, which forms the second division of Mr. Herbert Spencer's system of "Synthetic Philosophy," unifies in the great doctrine of Evolution all the leading generalisations of Biological science. The work was issued by the author in instalments, commencing January, 1863, and terminating March, 1867, when it was published in two volumes. It was selected by the Sociological Section for examination and exposition, in preference to the first division of the system—FIRST PRINCIPLES—as being specially suitable for study by the members of a Natural History Society. The "Principles of Biology" consists of six parts, and the following is a record of those members who have conducted the study at the monthly meetings of the Section during 1883-4-5-6:— The opening meeting was held on the 4th October, 1883, when Dr. Hill introduced the system by a discourse on "Organic Matter." Part I., "The Data of Biology," was conducted by Dr. Hill, F.I.C., Mr. F. J. Cullis, Mr. J. O. Barratt, B.Sc., and Mr. W. Greatheed. Part II., "The Inductions of Biology," by Mr. W. W. Collins, Mr. C. H. Allison, Dr. W. L. Hiepe, Mr. L. J. Major, Mr. W. B. Grove, B.A., Professor W. Hillhouse, M.A., F.L.S., and Mr. Wm. Matthews, M.A., F.G.S. Part III., "The Evolution of Life," by Miss Naden, Dr. Hiepe, Mr. W. H. France, and Mr. C. H. Allison. Part IV., "Morphological Development," by Mr. W. B. Grove, B.A., Mr. W. R. Hughes, F.L.S., Professor Hillhouse, M.A., F.L.S., and Mr. F. J. Cullis. Part V., "Physiological Development," by Mr. W. K. Parkes and Professor J. B. Haycraft, M.A., F.R.S. Edin.; and Part VI., "Laws of Multiplication," by Mr. W. B. Grove, B.A., Mr. W. R. Hughes, F.L.S., Mr. F. J. Cullis, and Dr. Hill, F.I.C. Abstracts of most of the papers read have already appeared in the "Midland Naturalist," and these will be followed by the remainder. The only exception is that of Miss Naden's paper on "The Special Creation Hypothesis" and "The Evolution Hypothesis," which was published by the Section *in extenso*.

During the progress of the study numerous illustrations by the microscope and otherwise were given, not only by the before-mentioned members of the section but also by other members of the Society, and notably by Mr. Thomas Bolton, F.R.M.S.

W. R. H.

THOMAS BOLTON, F.R.M.S.

Our readers will be interested to hear that at the meeting of the British Association recently held in this town a movement was originated among the members attending the committee of Section D (Biology), having for its object an application to Government for a small grant out of the Civil List to Mr. Thomas Bolton, of 57, Newhall Street, Birmingham (formerly of Kinver, Staffordshire), whose important services to science as a naturalist and microscopist have long been well known and appreciated by professors and teachers of biology not only locally but in every part of the United

Kingdom. Mr. Bolton established Science Classes at Kinver many years ago. It will also be remembered that at the recent International Fisheries Exhibition in London Mr. Bolton was awarded the Gold Medal for his exhibits of the microscopic food of fishes. The jury consisted of Professor Allman, Professor Ray Lankester, and other distinguished Naturalists. A memorial setting forth Mr. Bolton's claims, discoveries, and special circumstances was prepared by Mr. W. R. Hughes, late President of the Birmingham Natural History and Microscopical Society, and was signed by Sir J. W. Dawson, the President of the British Association, and by a large number of eminent men of science. It also received the signature of the Mayor of Birmingham. The memorial was recently presented to Lord Salisbury, as First Lord of the Treasury, and the following communication has just been received by Mr. Hughes from his lordship :—

10, Downing Street, Whitehall, December 18th, 1886.

Dear Sir,—Lord Salisbury has given his careful consideration to the memorial which you have placed before him on behalf of Mr. Thomas Bolton, and the representations of the numerous men of science by whom the memorial was supported, and his lordship desires me to say that he has had pleasure in recommending to Her Majesty that a Civil List Pension of £50 per annum should be conferred upon Mr. Bolton. Lord Salisbury has received the sanction of the Queen to this award, and steps will be taken to carry it into effect. The pension will commence as from the 1st July last.—I am, dear Sir, yours faithfully, J. F. Daly.

W. R. Hughes, Esq.

The numerous body of microscopists and others interested in natural science who have derived benefit from Mr. Bolton's useful researches in connection with minute animal life, and especially with the microscopic fauna of this district (on which it will be remembered he contributed an article to the recently published " Handbook of Birmingham "), will be gratified by this prompt and substantial recognition of Mr. Bolton's merits. Amongst those who signed the memorial were Professor Michael Foster, Cambridge, Secretary of the Royal Society; Sir John Lubbock, Bart, M.P., F.R.S.; William Carruthers, F.R.S., President of the Section of Biology at the meeting of British Association; Professor Ray Lankester, F.R.S., London; Professor Moseley, F.R.S., Oxford; Professor Bayley Balfour, F.R.S., Oxford; Professor Milnes Marshall, F.R.S., Manchester; Professor Allman, F.R.S.; Professor Alfred Newton, M.A., F.R.S.; P. L. Sclater, Ph.D., F.R.S.; Professor A. Macalister, F.R.S., Cambridge; Mr. H. B. Brady, F.R.S., F.L.S.; and the Rev Dr. Dallinger, F.R.S., President of the Royal Microscopical Society. The memorial was also supported by Sir James Sawyer, M.D., Professor of Medicine, and Professor B. C. A. Windle, Professor of Anatomy at Queen's College, Birmingham ; Professor Tilden, D.Sc., F.R.S., as President of the Birmingham Philosophical Society; Professors Bridge, Hillhouse, and Haycraft, of Mason College; and by Mr. R. W. Chase, President of the Birmingham Natural History and Microscopical Society. In a circular letter, thanking his numerous friends, Mr. Bolton assures the memorialists that this recognition of his work will be a great encouragement to him in continuing those biological researches in which he has always taken so deep an interest.

JOHN MORLEY, F.R.M.S.

One of the best-known naturalists of the Midland Counties has departed from our midst. On the tenth of last month, at the early age of fifty-seven, Mr. John Morley passed peacefully over to the great majority.

"He's walked the way of Nature,
"And, to our purposes, he lives no more."

Secretary of the Birmingham Natural History and Microscopical Society since 1876, Vice-President in 1875 and 1874, Librarian for the three previous years, and Curator in 1870, his connection with the Society, of which he was one of the earliest members, has lasted officially for seventeen years. During all these years, and especially during those in which the Society has been most active in its work, Mr. Morley's energies have been devoted, ungrudgingly and unselfishly, to furthering the interests of the Society and the pleasure and improvement of its members. In husbanding its resources, in laying out its work, in planning its excursions, his unfailing business faculty, his time, and his ever-ready help were always at the service of the Society, and have benefited it in a measure which cannot be over-estimated. His loss can scarcely be replaced, and the gap his departure from among us has made in the ranks cannot be filled except by the combined efforts of several persons.

Mr. Morley's scientific studies were confined chiefly to botany, and especially to the British ferns, of which his knowledge was very extensive. He was fond of growing strange varieties of the common species, and discovered or reared several forms which have been possessed by no other grower, including one from Ireland which is called after his name.

It was in connection with the excursions of the Birmingham Natural History Society, and particularly in the case of the marine excursions organised to distant places, that Mr. Morley's administrative talent was seen at its best. No such gathering, of which he had the direction, ever failed to please and instruct all those who took part in it. None of the little details of management upon which the success of an excursion depends was ever forgotten or misplaced. The last one in which Mr. Morley took part was that to Tenby, and the previous one that to Chirk, accounts of which are printed in the present number. The first sign that he was breaking down under the incurable disease from which he has suffered for several years was perceived during the Tenby excursion, but though the end was rather sudden, recovery was hopeless, and death a relief from pain.

Mr. Morley was emphatically what is known as a "good fellow." His genial temperament and inexhaustible good nature have smoothed over many a difficulty for his colleagues, and his loss will be felt by all those with whom he came in contact, not so much as that of a fellow-worker as of a friend who could always be trusted.

METEOROLOGICAL NOTES.—November, 1886.

The mercury, after a slight rise, fell to 28·874 inches on the 6th, its lowest point for the month, and, after fluctuating, rose to 30·705 inches on the 24th, its highest point, from which it again descended rather rapidly. Temperature was about two degrees above the average, the means, both of maxima and minima being in excess. The highest readings were on the 1st, when 59·0° was recorded at Henley-in-Arden, 58·7° at Loughborough, 57·1° at Hodsock, 56·0° at Coston Rectory, and 54·9 at Strelley. In the rays of the sun, 100·9° at Hodsock, 99·7° at Loughborough, and 92·3° at Strelley, also on the 1st. The lowest readings were 25·5° at Coston Rectory, on the 19th; 26·0° at Henley-in-Arden, on the 8th; 28·1° at Hodsock, on the 26th; 29·0° at Loughborough, on the 8th; and 29·2 at Strelley, on the 22nd. On the grass, 21·9° at Hodsock, on the 19th; 24·5° at Loughborough on the 8th; and 26·2° at Strelley, on the 22nd. Rainfall was nearly an inch below the average. The total values were 2·26 inches at Henley-in-Arden, 2·25 inches at Coston Rectory, 1·64 inches at Strelley, 1·25 inches at Loughborough, and 1·15 inches at Hodsock. The greater portions fell in the early part of the month. The number of "rainy days" varied from thirteen to twenty-one. The prevailing winds were south-westerly. Sunshine was rather deficient. Owing to the mildness of the weather, and the absence of severe frost, the foliage remained on the trees much later than usual; indeed, it was not till quite the end of the month that a general fall of leaves set in.

Wm. Berridge, F.R. Met. Soc.

12, Victoria Street, Loughborough.

Natural History Note.

Nais Hamata (A Fresh Habitat for).—Lately I have again found this interesting annelid, first discovered by Mr. T. Bolton in Sutton Park last year (1885), and described by him in the "Midland Naturalist." I mention this fact because Mr. Bolton describes it as *rare*. However, it has turned up this last October in considerable numbers in a well-known boggy pool near the town, and as was the case in Sutton Park, it was accompanied by a large number of beautiful forms, both animal and vegetable, amongst which I may mention, just as an example, the following:—*Conochilus Volvox*, *Volvox Globator*, *Anuræa serrulata*, and many other free-swimming rotifers, a large variety of the testaceous Rhizopoda, *Amœba princeps* (this in abundance), desmids, including Micrasterias, Closteriums, Peniums, Euastrums, Spirotæniums, and an abundance of that pretty typical palmellaceous Alga the *Eremosphæra viridis*. I shall be glad to find *Nais hamata* very common if it is *always* found in such good company as the above seems to indicate.—E. H. Wagstaff.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—General Meeting, December 7th.—Mr. W. B. Grove, B.A., exhibited *Rosellinia mammæformis*, from Sutton (new to the district); for Mr. H. T. Soppitt, *Ag. licmophorus*, with a photo of the same; *Geoglossum glabrum* and *G. viscosum*, from Yorkshire; for Mr. J. Hamson, *Xylaria polymorpha*, *Ag. proboscideus* (new to Britain), from Bedford; for Mr. W. H. Wilkinson, *Crucibulum vulgare*, from Wemyss Bay, and *Peziza purpurascens*, from Crieff. Mr. Blakemore exhibited an egg shell showing a kind of fungous growth inside the shell. Mr. W. H. Wilkinson then read a paper entitled "A Ramble amongst the Lichens," in which he described the results of a ramble on the Island of Bute, in search of these interesting, although lowly, plants. He exhibited nearly thirty specimens collected on that occasion, the chief characteristics of which he described, with the "habitat" in which each was found. His remarks were further illustrated by sketches on the blackboard and sections under the microscopes.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—November 22nd.—A paper was read by Mr. Wagstaff on "Old and New Forms of Fine Adjustment." The writer described the subject as one of great and growing importance to every microscopist, and one that was felt in proportion to the number of high powers used, and it ranked as one of the three essentials of every good instrument. The paper mentioned the weak points of many fine adjustments, one of the commonest being the apparent lateral motion of the object. Various movements were then reviewed, including the old side bar, side lever, Zentmayer's, Swift's patent climax, Campbell's, Royston Pigott's, said to read off the 400,000th of an inch, and Nelson's quicksilver adjustment; the latter as yet only existing in theory. The writer thought the Campbell arrangement, owing to its simplicity and efficiency, was likely to win favour in the future. The paper was illustrated by diagrams and instruments. November 29th.—Mr. C. F. Beale exhibited bony plates from the sturgeon. Mr. H. Hawkes, *Phragmidium mucronatum*, *P. bulbosum*, vars. *violaceum* and *rubi; P. obtusatum*, *P. gracile*, and *P. acuminatum;* Mr. J. Madison, *Zonites draparnaldi* and *Limnæa peregra*, va. *acuminata*. Under the microscope Mr. Hawkes showed slides of *Trichobasis suaveolens* and *Puccinia syngenesearum*. Mr. J. W. Neville, specimens of *Chalcis minuta*, from Turkey; Mr. H. Insley, ovary of *Loasa aurantiaca*. December 6th.—Mr. P. T. Deakin showed specimens of *Clausilia*, *Bulimus*, &c., from Palestine. An exhibition by the lantern microscope was given by Mr. W. Tylar, a large number of entomological and geological slides being shown. December 13th.—Mr. H. Insley showed a number of coal measure fossils, including a specimen of calamite with branches *in situ*. Mr. Mulliss exhibited some results of experiments in single and double staining vegetable tissues. A discussion on the fixing of the dyes closed the meeting.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY. —SECTION D, ZOOLOGY AND BOTANY. Chairman, F. T. Mott, F.R.G.S.—Monthly meeting, Wednesday, December 15th. Attendance seven (three ladies). The chairman introduced a discussion on the question "Is Bird-Song Music?" It had recently been asserted by the Rev. H. R. Haweis, and repeated by others, that there was no music in nature, and that the song of birds was not music. The answer to this question must of course depend upon the definition of the word "music." It was admitted that a musical tone depended upon the regularity and the rapidity of the air-waves. There could be no doubt that there were many musical tones in nature, including the notes of many birds. But it might be said that music consisted of musical tones arranged in musical phrases, and that bird-song was not so arranged. Surely, however, the phrases of the thrush, the blackbird, the nightingale, &c., were often musical in the truest sense. The programme for the ensuing quarter having been discussed and determined, the chairman read a short paper on "Foreign Fruits available for acclimatisation in England," describing the processes by which plants might be rendered hardy in climates to which they were not originally adapted, and pointing out nine valuable fruits on which it would certainly be worth while to try the experiment of gradual acclimatisation.

PETERBOROUGH NATURAL HISTORY, SCIENTIFIC, AND ARCHÆOLOGICAL SOCIETY.—December 13th.—Opening of the Society's Museum in the new premises, Minster Close. The Very Rev. the President occupied the chair, and was supported by the Mayor (H. P. Yates, Esq.) and Lieut.-Colonel Strong. The Dean in the course of his address said they were gathered on an historical site, the building having originally been a chapel founded in honour of Thomas à Beckett, by Abbot de Waterville, the same abbot who built the transept and central tower of the Norman cathedral, and completed by Prior Benedict, his successor; and full of zeal for the friend he had lost he brought with him certain precious relics, consisting of the shirt and surplice Thomas à Beckett had worn, and some of his blood gathered from the stones of Canterbury Cathedral; these the abbot deposited in the chapel. Abbot George pulled down the nave of the chapel—it was only the chancel they met in—and gave the materials for the building of the parish (St. John Baptist's) church. Later it ceased to be used as a chapel and was handed over by order of Henry VIII. for the purpose of a King's School, and King's School it had remained until a year ago, when they had to move the school to the new site, and so the chapel was left empty. He rejoiced that for the present this society should find its home and dwelling place there, but hoped that it would occupy a first place in connection with a Free Library and other public buildings before many years had passed; and was sure they would all feel that the opening of the Museum that night was an augury of future success and would all do their utmost to promote the welfare of the society. The Mayor next addressed the meeting and was very surprised at the altered appearance of the building from what it was when he was first acquainted with it in 1828. He welcomed the society there but thought the building ought to be used for the Chapter Library, but that could not be at present. Seeing the society were desirous of purchasing all the back numbers of the Palæontographical Society's works he should be most happy to give £5 towards that object. Mr. J. W. Bodger, the Hon. Secretary and Treasurer, then gave an interesting report of the history of the society from its commencement in 1871, through the instrumentality of the late Mr. Bentley. The Museum was commenced in 1880, and owing to the kindness of the Dowager Lady Huntly, the President, the Mayoress, and many others, they now could call the treasures displayed that evening their own, excepting a few groups of specimens which were as yet only lent to the society, including the magnificent Roman bronze equestrian figure, the property of Dr. T. J. Walker. Lieut.-Colonel Strong proposed a vote of thanks to the President, to the Mayor and Corporation for their attendance, and he wished to include the name of Mr. Bodger in the vote of thanks, as he had for the past thirteen and a half years worked so hard for the society as Honorary Secretary. The Dean in acknowledging the compliment said he almost felt ashamed because the kind friends in Peterborough so over-rated the little he had done, but he did feel the Secretary did merit their most hearty thanks, as it was mainly owing to his exertions the society was in its present position. The President then declaring the Museum open, microscopical exhibits were made by Messrs. A. Gee, C. A. Beale, and G. W. Leigh. Mr. Beale exhibited young oysters, Polycistina from Barbadoes, gold quartz, eye of drone fly, micro-photographs, and by polarised light, sulphate of calcium, cocoon of silkworm, and various kinds of hair. By Mr. A. Gee, elytron of diamond beetle *(Entimus nobilis)*, gemmules of sponge *(Gossia)*, embryo oyster shells, Polycistina from Barbadoes and San Domingo, fossil diatoms from Stoney Ford, Armagh, polyzoa *(Bugula plumosa)*, diatoms *in situ* on algæ *(Isthmia nervosa)*, North Atlantic soundings (two miles deep), ditto (422 fathoms deep), injected skin of salamander, section of human skin showing perspiration glands and ducts. For Mr. J. W. Bodger, various plant sections illustrating the different forms of tissue, plumes of moth *(Nepticula)*, bones from the mouth of a star-fish, cartilage from ear of common mouse, sting of wasp, leaf of sundew *(Drosera rotundifolia)* with insects *in situ*. By Mr. Leigh, section of human scalp showing roots of hair. Section of young palm, ooze from the Atlantic bed (2,000 fathoms); *Ptilota serrata*, North America; eye of gadfly, spiracles of water-beetle *(Dytiscus marginalis)*. The Roman and Saxon remains from Peterborough and the neighbourhood attracted considerable attention.

PRESIDENT'S ADDRESS.*

BY R. W. CHASE.

(Continued from page 6.)

Returning to the cuckoo. I believe that, being a voracious feeder, it requires a considerable tract of country to sustain one, and that upon arriving, each bird takes up its abode in a certain neighbourhood, and uses such nests as are plentiful in that locality. It is the scarcity of suitable nests that causes us to hear of a cuckoo's egg being found in the nest of such species as the magpie, &c.

Concerning the coloration of birds' eggs in general, these beautiful tints and varied markings must at once strike even a casual observer.

I think there is little doubt that the chief use of colouring in eggs is protective, or, I may say, entirely so. The means by which the various colours are produced is more difficult to assign.

Some writers consider that the colour in eggs is influenced by the plumage of the bird, and that the colour, etc., of one is dependent upon and analogous to the other; to a certain extent this may be so, as food and organic substances introduced into a bird's system affect the colour of the plumage. I see no reason why the colouring matter of the egg shell should not likewise be acted upon. It is a fact that the same species inhabiting distinct and different localities will differ in the colour of their plumage and eggs; for instance, denizens of Fenland will have full and darker plumage and lay more richly coloured eggs, whereas those occupying high, dry, sandy districts will be pale in comparison. That birds are able to control or alter the normal markings upon their eggs, at will, I consider absurd, although we find an endless variation, both in ground colour and markings, in most eggs, but especially so in some species, the tree pipit, for instance. At the same time, I am convinced that the bird is quite an involuntary agent in the matter. Nor can I agree to the supposition that birds who now lay spotted or marked eggs in covered or domed nests will ultimately lay white or unmarked eggs, because there is no further necessity or use for the markings, as the nest affords protection from discovery.

* Transactions of the Birmingham Natural History and Microscopical Society.

Neither can I believe it likely that those species who now lay white eggs upon the ground in open nests will some day develop markings as a means of protection.

Let us notice a few birds that lay their eggs on the bare ground in exposed situations, trusting entirely to the close similarity of the colouring of their eggs to their surrounding for safety. For instance, take the eggs of the oyster catcher, or ring dotterel, laid on the bare shingle or sand, which you will frequently walk over without discerning them from the surrounding material, and I know instances where a nest has been found and left, with the intention of securing the eggs upon the return journey, when it was impossible to come across them again the second time. Norfolk plover, lapwing, Arctic and Sandwich terns are like examples.

This marvellous harmonising with the surroundings does not strike you when you see a clutch of eggs lying upon cotton wool in a cabinet, or holding one in your hand, but you require to view in the open on their bed of shingle, or earth, to thoroughly appreciate the beauty of such an arrangement. The young of those species with these nesting habits depending entirely for safety upon their coloration, when first hatched are covered with down, the tints of which are in such complete harmony with the stones and lichens that often you would not discover the immovable crouching little beauties unless you happened to see a bright little eye watching you.

I well remember the difficulty I had in finding some young golden plovers in Perthshire, amongst the heather, so closely did they resemble the golden moss and lichens, and as they had ran from the nest I was more than half an hour in securing three. Upon the first symptom of alarm the parents at once leave their offspring and endeavour to draw attention upon themselves by their actions and cries, well knowing that their presence with their—often—conspicuous plumage in proximity to their young would at once proclaim their hiding place.

Other ground nesting species, such as grouse, partridge, pheasants, do not trust to the colour and markings of their eggs for protection so much as to the harmonious blending of their own plumage with the adjacent greys and browns of hedgerow and moor. Cases are known where the old bird has had to be touched before she would leave her nest and so expose the treasures she was covering.

In the case of the pheasant the male takes no part in incubation but leaves those duties to his sombre-coloured mate; this species is polygamous like most of the gallinaceous genera.

The nightjar might also be mentioned as another example. Many of the Anatidæ, or ducks, also nest upon the ground and lay nearly white or cream-coloured eggs, which would be most conspicuous if exposed, but the old duck before leaving carefully covers up the eggs with down plucked from her own body. She also, as a further safeguard, skulks away some distance from the nest before taking wing. The eider ducks in the Farne Islands exemplify this habit to perfection, covering their eggs with the greatest care, to protect them from the gulls, who would very soon make short work of a nest of eggs if exposed to view.

The Anatidæ ought certainly to have developed markings to protect their eggs,—if what the evolutionists tell us is correct—that their ancestors formerly nested in holes where no protective markings were required.

The majority of birds laying white eggs usually deposit them in holes amongst rocks, in trees, or in burrows in the earth, as the swift, rock dove, owl, woodpecker, wryneck, kingfisher, shearwater, and petrel; others that lay white eggs in exposed situations are notably the ring and turtle dove, whose eggs seem to court your notice, placed on a slight platform of twigs and roots, only an apology for a nest, so scanty, in fact, that you can often see the white eggs showing through. Now supposing that these species have descended from hole-breeding ancestors—the rock dove breeds in holes at the present time—how is it that they have not developed colour and markings as a means of protection? I expect the answer will be that a sufficient time has not elapsed for them to have developed the means, but that they will do so. I have never yet heard of an instance where even slightly marked eggs have been found, which would show some tendency towards that result. The other cases where white eggs are exposed mostly occur either in those species which breed in colonies, and are able by their numbers to repel attacks from their natural enemies, or else in the Falconidæ, like the Hanius, who lay generally white eggs exposed to view. I think in this case that the eggs are rarely left without one of the old birds, as it is well known that amongst this order, incubation commences directly the first egg is laid, and also that the male brings food to the nest for his mate, consequently she is not obliged to go far from home, and, I imagine, the natural enemies of such birds have little chance of destroying eggs so well guarded. I do not class man amongst the natural enemies of "Bird Life," because when he steps in the balance of nature is sure to be upset, but with respect to such vicissitudes and dangers as each would have to combat with for their existence in an undisturbed state of nature, we find that in all cases ample provision has been made for the needs of each individual species, so as to preserve the balance of creation. "Each has its allotted space to fill and duties to perform."

I now come to the largest group, viz., those birds that lay beautiful eggs cradled in perfect gems of ornithological architecture. I think we shall find that in these species there is a considerable amount of affection and tender care displayed for the progeny. You must certainly know with what valour and determination a robin or a flycatcher will defend their nest from a cat, for instance, by exerting their puny powers to the utmost, returning again and again to the attack, and will often succeed in driving off the intruder. Moreover, the young when hatched are naked, perfectly helpless, unable to feed themselves, and frequently blind; an exact opposite to those species who deposit their eggs on the ground, and have the young covered, and able, immediately upon leaving the shell, to procure their own food. I think the variation of ground colour and markings is considerably more in this group than in any other. I therefore place considerable importance upon the structure and material of the nest in determining the species, as they do not vary in anything like the same degree as the eggs. Take, for example, the willow and wood wrens; it is quite possible to find two clutches of eggs so much alike that they would answer to either species; but, supposing one clutch was found in a feather-lined nest and the other without, I should have no hesitation in assigning the eggs found in the feather-lined nest to the willow wren, as that species always uses feathers, whereas the wood wren does not. Take the nest of the blackbird and thrush; the former constructs its nest of mud fibres and bents, forming strong walls, lined with finer bents or fibres. The latter constructs a similar one, but usually lines it with a smooth coating of cow-dung. The differences in the nests of these closely allied species are not to be accounted for by any acquired knowledge or experience, but clearly show that Providence has, for some wise purpose, ordained each of these species to construct its nests most conducively to the well-being of their offspring, and it is our ignorance that prevents us from ascertaining the particular reason for such difference.

Those species forming compact nests with helpless young rarely leave the nest for any length of time, but one or other of the parents keeps watch in close proximity, to render protection in case of need. The magpie is a notable instance as an exception; to obtain food for the young, the parents often have to go far, and leave the nest for a considerable period, so as a means of protection a covering of twigs is placed over the nest, leaving a hole at the side for entrance. How came the magpie to adopt this method? From experience? I think the only schoolmaster employed was "Instinct, or an involuntary stimulus of an innate unknown power," causing such action without any intervention of reason as the result of such actions.

I therefore think we may conclude that (1) colour, both in birds and their eggs, is intended as a means of preservation of their kind from natural enemies by the adaptation of their hues to the colour of their surrounding in their usual habitat; a most forcible instance of design, clearly pointing to the existence of an "omniscient great First Cause."

Mudie has beautifully illustrated it by comparing "the ptarmigan to lichen rock in summer, hoar frost in autumn, snow in winter; grouse are brown heather; black grouse are peat, bank, and shingle; partridge, clods and withered stalks all the year round."

(2) That any variation from the normal coloration is not due to any action of the birds themselves, but is caused by the amount of nutriment obtained, or some speciality in the soil or climate they may inhabit, such variation being often only slight and hardly ever permanent.

Alteration in colour is easily obtainable; the high colour in canaries produced by cayenne feeding, the dark bullfinches by hempseed, from which unnatural causes (such extreme cases not being found in nature) erroneous conclusions are drawn.

The most remarkable variations are those obtained in animals or birds in a state of confinement or domestication, consequently not proper or safe examples upon which to found theories.

(3) That in cases where the eggs are not protected by their colour, the plumage of the parent assimilates with the surroundings instead, and that in many cases, upon the old bird leaving the nest, the eggs are covered up.

The case of the wood pigeon and turtle dove is most puzzling, and I must confess that I am unable to solve the mystery, which I put down to my want of knowledge, but at the same time cannot accept the theory that having descended from hole-breeding ancestors, they have adopted the system of nesting in trees and hedges as an improvement; by the same argument, they ought to have adopted coloration as a means of protection by concealment, which they have not. That nests are not constructed by "imitation or memory," but from instinct inherent, or as it has been expressed, "an involuntary desire, acting on the mind without intervention of reason, motive, or deliberation, but tending uniformly and exclusively to the preservation of the individual or propagation of the race."

What I want to be shown are some of the so-called transition stages, or else positive proof that a given species formerly constructed its nests quite differently.

The subject I have addressed you upon is, I know, a very debatable one, and it is quite possible, with the mass of evidence, both for and against, to make a strong case for either side; but before I alter my views, I want more conclusive evidence, when I shall be quite willing to do so. I sincerely hope that others, with more time and ability than myself, will take this matter up, and endeavour to elucidate some of its mysteries. This must be my excuse for troubling you with what I fear has been a very uninteresting address and allow me to express my grateful thanks for the very courteous attention with which you have listened to me.

THE MIDDLE LIAS OF NORTHAMPTONSHIRE.

BY BEEBY THOMPSON, F.G.S., F.C.S.

PART IV.

The Middle Lias Considered as a Source of Water Supply.

(Continued from page 298, Vol. IX.)

There is, perhaps, no social question of greater importance at the present time than that of the supply of pure water to large towns; and since many people seem to have the idea that Water Companies or Corporations can always get abundance of water if they will only go to the trouble and expense of digging, or boring, or some such operation, I have thought it advisable, as a prelude to the scheme I have to propose for the water supply of Northampton and district, to consider the various possible sources of water and the reasons of their failure, or for or against their rejection as a supply to that district; an additional reason being that I shall endeavour to show later on how some of these inadequate sources may be made helpful to the Marlstone supply.

Under the heads of Springs, Rivers, and Lakes (natural or artificial), we might perhaps group all the various methods adopted for water supply in this country. Wherever it is possible to obtain a copious supply of drinkable water from a spring, that is undoubtedly the most desirable source for a town, because, if from a sufficient depth to yield good potable water, it will not fluctuate in quality, quantity, or temperature, as water from the other two sources would, and until recently Northampton was furnished with such water. This supply was obtained from the Marlstone, and, as has been pointed out before, this is the chief water-bearing bed of the county West and South-west of Northampton.

Although a deep seated water source may be exceedingly desirable, it cannot always be had, from a variety of causes, and it is remarkable that some of our largest towns are supplied partially or entirely otherwise. Probably no town uses such a large quantity of river water as London, for out of a daily supply of about 178,000,000 gallons (September, 1886), some 90,000,000 gallons are obtained from the Thames above Teddington Lock,* a fact which clearly shows the possibility of obtaining a satisfactory water from ordinary surface drainage by artificial filtration.

There seems to be a growing desire on the part of the governing bodies of our large towns to utilise the waters of existing *lakes*, or to construct artificial *reservoirs*. Some natural lakes have already been appropriated to the water supply of towns. I may particularly mention Loch Katrine and Thirlmere, the former by Glasgow and the latter by Manchester.

It is extremely doubtful whether it is a wise course for Parliament to allow of the monopoly of such supplies of water by any one town, and some very pertinent remarks were made on the subject by Mr. G. J. Symons, F.R.S., the Secretary to the Meteorological Society, in an address on "Water Economy," delivered before the Sanitary Institute of Great Britain in 1879.

It is not my intention to speak for or against any of these systems as applied to other districts, but having noticed the fact that they are applied, it will be necessary to consider only the reasons for or against their adoption in Northamptonshire.

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* "Sanitary Progress during the Reign of the Queen," by Captain Douglas Galton, C.B., F.R.S. Address delivered at the opening of the Session of the Society of Arts.

The various springs of the county may, for present purposes, be classified as below:—

1.—River Gravel Springs.
2.—Drift Gravel Springs.
3.—Great Oolite Springs.
4.—Inferior Oolite Springs.
5.—Marlstone Springs.
6.—Trias Springs.

THE RIVER GRAVEL SPRINGS.—Along most river valleys there is on each side of, and below the present restricted water channel, an accumulation of matter newer than the river itself, and evidently owing its accumulation to that river. This alluvial matter, in the case of the Nen Valley, consists of a deposit of sand and gravel, covered in the lowest parts of the valley by a dirty looking mud or clay containing much vegetable matter.

The River gravel apparently dips below the present river and its alluvial clay bed, but rises some little distance above the ordinary level of the river on each side, forming low meadow lands, or in some cases, as for instance in the Cow Meadow at Northampton, a distinct *river terrace*. This bed is of *Palæolithic* age, and has yielded numerous remains of the Elephant (two species), Rhinoceros (two species), Hippopotamus, Ox, Horse, Wild Hog, and Red-deer, and also a few flint implements.

The bed is sometimes worked for gravel in Northampton, and an extensive bed of it between Barnwell and Oundle is worked by the railway company for ballast.

The *Alluvium* proper is practically impervious to water, and certainly more recent than the gravel. It contains the remains of the Ox, Red-deer, Horse, Wild-hog, and numerous freshwater gastropods, such as Anodonta, Physa, Planorbis, Limnea, &c.; also human remains. The thickness of the alluvium is very variable. The clay and gravel together may reach thirty feet or more in places, and where both are present they seem to have a thickness inversely to each other, though on this point I cannot speak very definitely.

The river gravel rests upon Upper Lias clay, and hence we have all the conditions for the formation of a *Land Spring*, and such a spring we find.

Some few wells in Northampton are fed by water from this river gravel, and it was even proposed to utilise it for the water supply of the town, but this scheme fortunately found little favour, as also a proposal to pump it into the same reservoir with water from other sources.

It is a characteristic of these *land springs* that they vary considerably with the seasons, both in quantity and quality, and in dry seasons frequently fail altogether, for the double reason that the accumulation of water is not large, and they are not without the influence of the evaporative power of the sun aided by capillarity and vegetation. The quality of the water from such springs is sometimes satisfactory, but much more often decidedly bad. In the particular case under consideration, this source of supply may be condemned for several reasons. (1.) The river gravel is either not at all, or only slightly, overlaid by impervious matter, and so the water is easily contaminated from the surface; besides this, one of the main sewers of the town passes through a portion of this bed, not very far from the situation once proposed for a pumping station, and so at any time the water might have become contaminated with the most dangerous of all impurities. (2.) The water is so near the surface and the bed so inconsiderable in thickness that it cannot itself yield water sufficiently well filtered for domestic use. The general character of the water will be seen from the following analysis, which must be taken as a mean of several:—

Solids	72 grains per gallon.		
Chlorine	6·2	do.	do.
Nitrites	A little.		
Nitrogen in nitrates and nitrites ...	2·5	do.	do.
Free ammonia	·31 parts per million.		
Albuminoid ammonia	·18	do.	do.

The solid residue charred a little on being heated, and during the operation emitted the disagreeable odour characteristic of ignited organic matter. (3.) The water is not sufficient in quantity for a town supply. I know of one instance in which rather continuous pumping at one well drained another about a quarter of a mile away in a very short time—a day or two—and, of course, any contamination would be all the more injurious because of its comparatively small dilution.

This water was for a time used for flushing purposes, and this was, of course, a very legitimate use for it when better water was very scarce.

It may be said in favour of this water that it is well clarified, and rather bright and sparkling in appearance. The bed seems to offer considerable facilities for the oxidation of organic matter, owing to the fact that there is considerable variation in the water level with the season, and each time the water level sinks air follows, which latter is again largely expelled and partly absorbed by the next influx, and so a rather good aëration is the result.

Drift Gravel Springs.—A considerable portion of Northamptonshire is covered by *Boulder clay* or *gravel* deposited during the Glacial period, and the gravel furnishes very numerous springs of pretty good water, where it rests upon impervious beds. Besides this there are some rather extensive deposits of a fine sand or gravel, differing considerably from the ordinary drift gravel, though probably of the same age. These latter deposits appear to be very local, and to consist of redeposited Northampton sand, as none of the flints and pebbles, &c., so enormously abundant in the ordinary drift are present, whereas fragments of ironstone are very common. There is a tolerably extensive deposit of this form of drift within a few miles of Northampton, and during the discussion on the water supply of the town, Mr. Westley, of Kislingbury, several times urged the adoption of it as a source of water. The particulars which Mr. Westley gave were about as below:—"Catchment area about 12,000 acres, extending for about five miles through the parishes of Courteenhall, Collingtree, Milton, Rothersthorpe, Kislingbury, and Bugbrook, with a width varying from twenty to fifty chains (say an average of twenty-five chains), and a thickness of twenty to forty feet of sand, from which good and never-failing springs issue. Assuming fifteen inches of rainfall absorbed, it would yield a yearly supply of 408,000,000 gallons, or rather more than 1,000,000 gallons per day." This scheme was not entertained, and even supposing the amount of water estimated by Mr. Westley could have been realised, it is not a quantity adequate for the supply of Northampton; and being very superficial, it would be open to some of the objections urged against the River gravel springs. It is so situated that water could not be stored in it to any great extent, and so in times of drought it might fail altogether, I do, however, think that a supply of water like this might be made useful, and the particular feature of the scheme I have to propose is that such partial supplies could be used at comparatively little expense.

The Great Oolite Springs.—Most of the high lands around Northampton—Kingsthorpe, Dallington, Duston, Wooton, Blisworth, Moulton Park, &c.—are capped by limestone of Great Oolite age, a rock which allows water to percolate through it; and alternating with the limestone are beds of clay—sometimes two, at other times three—which, owing to the resistance they offer to the passage of water through them, give rise to springs. Generally these springs are very inconsiderable, for these and possibly other reasons:—The intervening clay beds are more or less calcareous, and so do not offer as great resistance to the passage of water as the stiff clays of the Lias; also, they are comparatively thin, the greatest thickness of clay in one bed that I have myself recorded being 15 feet 1 inch; further, they are succeeded downwards by the Inferior Oolite, the whole of which is very porous.

The best springs occur near the top of the formation, at the junction of the Cornbrash with the Great Oolite clay, but all of these are far removed from Northampton, and so need not detain us.

THE INFERIOR OOLITE SPRINGS.—Below the Great Oolite beds just referred to, we have another set of porous beds yielding a much larger supply of water. They belong to the lower part of the Inferior Oolite, and may be distinguished as below:—

$$\left.\begin{array}{l}\text{Lower Estuarine Series}\\ \text{Ironstone Beds}\end{array}\right\}\ \text{Northampton Sands.}$$

The Lower Estuarine is the upper bed of the Inferior Oolite in that part of Northamptonshire we are concerned with. It is nearly pure sand and very porous; vertical plant markings are plentiful, but it contains no fossils. The lower portion of the Northampton Sand is what is worked as an ironstone in the neighbourhood, but it sometimes becomes calcareous, and both it and the more indurated portions of the Lower Estuarine are at times used as building stones. They are both rather variable in character and in thickness, the maximum thickness being about eighty feet, and the lower one rests upon an eroded surface of Upper Lias clay.

The accumulation of water on the surface of this Upper Lias clay gives rise to many free springs, particularly as the Northampton Sand in the neighbourhood of Northampton generally forms a cap to the hills, the sides of the hills affording a ready vent for the water. Amongst the many well-known springs in and around Northampton having an origin of this nature, I may mention "*St. Thomas à Becket's Well*," "*Scarlet Well*"—now very properly closed—the "*Old Nine Springs Well*," which used to be on the Billing Road, opposite to what is now Victoria Road; the spring in *Gypsy Lane*, that on the *Race Course*, and "*Lumber Tubs Spring*," &c.

In addition to these freely running springs, there are many pumps in and around the town getting their supply of water from this same source, but the number is gradually diminishing.

From about 1400 to 1848 the town was supplied with this water; and from 1837, the date when the Water Company was formed, to 1848, this was the only source of supply the Water Company had, and it was obtained from a well near the Billing Road, where the present deep well is, and conveyed to a reservoir on The Mounts, near to the Borough Jail. The source of the Ise and one of the sources of the Nen are supplied from these Inferior Oolite springs.

There is a fairly abundant supply of water from the ironstone springs of this neighbourhood—altogether, probably, sufficient for the use of Northampton if it could be collected and utilised; but this, I think, is impossible for several reasons; and, as so many people in the town still have a very high opinion of the quality of the water from these sources, I may as well point out the objections to it.

In the first case, there would be considerable difficulty in getting the supply from these beds, because the beds themselves are most frequently found in this neighbourhood only capping the hills, in which situation no considerable accumulation of water could take place in any one hill, the water can so easily discharge itself on the sides; and to collect the water from a number of hills would be a very expensive undertaking. Of course, the water running from these hills finds its way into channels—brooks and streams—and ultimately into the river; but then it has all the drawbacks of a river supply. During the great scarcity of water a year or two back, the water from these beds on a hill to the north-east of Northampton was utilised, and formed a very valuable addition to the rapidly diminishing Marlstone supply. By going further away from Northampton, some of the drawbacks above alluded to, and those to be alluded to, would be obviated; and at the present time, largely assisted by the Drift, the Northampton Sand does furnish Northampton with water.

Secondly: These springs are rather superficial; the water has not to pass through much sand—the filtering medium—either to get down to the clay or to find an exit; consequently, although it is an excellent filtering medium, water from this bed near to towns or villages must be regarded with suspicion. As a matter of fact, water from this bed in the town and some of the adjacent villages is not good. Most of the public springs and pumps in the town have been condemned and closed.

Thirdly: Since by far the greater part of Northampton is built upon the Inferior Oolite, nearly all the culverts are laid in it, also the cemetery and all the graveyards are in it, so that it is open to the most serious kind of contamination, and to my certain knowledge it has at times received a considerable amount of sewage matter. The water from Thomas à Becket's Well is distinctly deteriorated after the manuring of the gardens situated near it.

In speaking thus of the Inferior Oolite springs I do not wish to underrate their value, but only to condemn that water which is obtained from them in and near the town, and even more so that which is obtained from them in some few villages where proper drainage works do not exist.* As a matter of fact, very large quantities of good water are obtained from this formation; indeed, in some places in this and neighbouring counties it is the chief or only supply. Mr. De Rance says that "Unpolluted spring water from the Oolites is unsurpassed in its comparative freedom from all kinds of organic matter;" and "They are bright, sparkling, and palatable, and excellent for all domestic purposes except washing, but the hardness is mostly temporary, and so capable of being removed by Clarke's process."

(To be continued.)

ON THE CAUSES OF GLACIER MOTION.†

BY W. P. MARSHALL, M.I.C.E.

Glaciers have their origin in the snowfall above the line of perpetual snow. All the share of rain that is due to fall in the particular locality, instead of falling in a liquid state and at once passing away to the lower regions of the mountains and valleys as rivers, falls in a frozen state as snow, which remains where it falls, and accumulates in the higher regions of the mountains. At all places above the level where the annual snowfall exceeds the annual melting from the direct heat of the sun, combined with the evaporation from the surface, the mass of snow upon the mountain tops would receive a permanent addition every year, and the heights of the snow mountains would undergo continuous increase, rising higher and higher indefinitely if there were not some counteracting influence to prevent this rising. This counteracting influence is the "Glaciers," which are in reality

* One of the worst waters I ever analysed came from a village where these remarks would apply.

† Transactions of the Birmingham Natural History and Microscopical Society. November 23, 1886.

continuous descending streams, that as effectually drain and keep down the level of the great snowfields, as rivers drain and keep down the level of lakes. In consequence, however, of the glaciers being frozen water, their motion is very different to that of liquid water, and becomes complicated by several interfering causes.

The snow suffers compression and consolidation from the weight of the accumulated mass, and this pressure becomes so intense under the enormous masses that the snow crystals are ultimately welded together into a solid transparent block of ice in the same way as two blocks of ice can be united by sufficient pressure, the two blocks being united into a single undivided block as completely as two pieces of iron are welded into one when pressed together at the right temperature. The cementing together of the snow is further aided by the trickling down of the surface water from the partial melting of the snow that is caused by the heat of the sun's direct rays in the middle of each day.

The glaciers are irregular streams of this ice, extending to half a mile in width, 300ft. in thickness, and six miles in length, in Switzerland; but they are considerably larger in other countries, and especially in Greenland, where the largest known glaciers exist, one of which is as much as three miles in width and thirteen miles in length. These, however, appear quite insignificant when compared with the gigantic glaciers, of which there are distinct traces, from the "Great Ice Age," when the Rhone Glacier in Switzerland, for instance, must have been no less than 120 miles in length and 2,000ft. in thickness.

In the motion of glaciers, gravity, instead of being the sole moving cause as in the case of rivers, is only sufficient to account for a small portion of the work that is done. The velocity of motion of water in rivers bears direct relation to their rate of fall or inclination, but the velocity of motion of ice in glaciers bears no relation whatever to the inclination of the glacier. The most rapid moving glacier—the one in Greenland already referred to—is very flat, and has much less inclination than the slow moving glaciers. The Mer de Glace in Switzerland, with a slope of one in twelve, does not move faster than 3ft. per day; but the Greenland glacier, which has a slope of only about one in one hundred and twenty, has a motion of as much as 65ft. per day, or twenty-two times the velocity, with only one-tenth of the inclination.

Some other cause than gravity has, therefore, to be looked for, and various ingenious theories have been proposed to explain the motion of glaciers; but these have failed to satisfy the conditions that are observed. Ice has been looked upon as a "viscous" body, and having something of the properties of pitch, which, although brittle and fracturing like ice when cold, will, if a lump is left for some time, gradually sink down and flow outwards on all sides, or travel down an inclined base, the rapidity of motion depending upon the temperature to which it is exposed. But this theory is found to be not applicable to glaciers, because their motion is found to be independent of temperature to a great extent, and their rate of travel is nearly as great in winter as in summer, being about four-fifths as much in winter as in summer.

The only explanation that appears to fit all these circumstances is the one originally proposed by the late Canon Moseley, namely, that the motion is caused by the daily alteration of expansion and contraction in the ice from the exposure to the direct heat of the sun in the day and the intense cold of the night. The amount of this action will depend not on the *actual* temperature at any time, but upon the *difference* of temperature between mid-day and mid-night, which will not be much less in amount in winter than in summer. When the expansion of the ice takes place in the glacier it will have effect mainly in the direction where movement is easiest, that is, down the valley; but when the contraction subsequently takes place, as the expansion is *assisted* by gravity whilst the contraction is *opposed* by gravity, the movement upwards from contraction will be somewhat less in amount than the movement downwards from expansion, and the result will be that the mass will be permanently displaced a small distance down the valley. By the repetition of such alternate daily expansions and contractions the glacier is moved gradually from the top to the bottom of its course.

This action is directly analogous to what is well known as the creep in the lead covering of roofs; the lead is constantly endeavouring to creep down the slope of the roof, in consequence of being exposed to daily alternations of expansion and contraction from change of temperature, and any movement downwards is assisted by gravity, whilst the return movement upwards is opposed by gravity. That the total force available in this manner in the case of a glacier is very large in amount will be seen from a consideration of the circumstances. It happens that the rate of expansion and contraction of ice under changes of temperature is very high, being as much as 1—35,000th of the length for each degree of temperature Fahr. (which is three times as great as the rate of expansion in brass); and in the case of the Rhone Glacier, six miles in length, this amounts to about 1ft. for each degree, or for a difference of temperature of only twenty degrees between mid-day and mid-night there is as much as 20ft. change of length in the glacier daily, lengthening 20ft. every day and shortening again nearly, but not quite, 20ft. every night.

In the case of the Greenland glacier, which moves at the extraordinarily rapid rate of twenty-two times as fast as the Swiss glaciers, there is an enormously greater moving power if, as there seems good reason to assume, the entire surface of that large country, 700 miles in width and 1400 miles in length, is covered with a thick mass of snow, consolidated more or less throughout the whole extent to the condition of glacier ice. Then the whole of that immense area will expand daily from the centre on all sides towards the coast, and the only outlet for this expansion will be along the several valleys and ravines leading to the sea, producing a glacier along each of them. The distance from the centre of the country to the coast, 350 miles, gives a daily expansion of no less than 50ft. per degree of temperature, or a total of 1000ft. for the twenty degrees difference of temperature taken before, as occurring daily between mid-day and mid-night. The result of this would be a daily movement of advance and receding of 1000ft. all round the coast if there were a free exit all the way round; and when the exit is confined to the several valleys and ravines leading to the sea, through which the whole advancing mass of ice has to be crowded, it does not seem unreasonable that the actually observed result should be obtained, namely, an actual advance of 65ft. per day in the coast glacier.

When it is considered that this enormous propelling force is constantly forcing outwards the glaciers through the only outlets by which they can escape, and that this escape of the ice must take place, whether the glacier bed is at a great or a small inclination, though not at the same rate, it will be seen that a glacier may exist with a very small slope, such as the slope 1 in 120 named of the Greenland glacier, and that if the bed were to become level, or even turn upwards towards the outlet, the glacier motion could not be stopped. This latter case actually exists, and there is a glacier that really moves up hill in the latter part of its course, a circumstance that does not seem to admit of explanation by any other theory than the one described.

The transverse crevasses of glaciers are a marked feature; they are numerous irregular cracks of large dimensions, extending a great depth into the mass of ice, and have been suggested to be caused by a bending of the ice stream over the edge of an increased slope in the bed of the glacier. But this seems an insufficient cause to account for the circumstance, and the theory described above offers a very simple and sufficient explanation. In the daily contraction of a glacier, the small strength of cohesion of the ice, and the very great friction of the bed, will not only absolutely prevent the whole glacier being pulled back as one mass, but will necessarily result in its being pulled asunder transversely, and pulled to pieces, thus forming the transverse crevasses.

Another important point that has to be referred to is the scoring and grooving in longitudinal lines that takes place in the bed of glaciers, and that has left such remarkable records of the ancient glaciers of the "Great Ice Age." These are great scratches, amounting in many cases to definite grooves, that have been formed by the scraping along of hard stones under the enormous pressure of the great mass of glacier; but when the amount of force is considered that must have been employed in ploughing out such grooves in hard rock, it is seen that this cannot have been effected by the simple passage over it, once for all, of a stone embedded in the ice. If, however, the glacier descended by a long-continued series of oscillations, according to the theory here named, so that the stone passed a great many times over the same spot, backwards and forwards, the result becomes intelligible.

The above-named theory of glacier motion, which originated with Canon Moseley, was further developed after his death by the late Mr. Walter Browne, from whom I obtained most of the information given in this paper.

THE PRINCIPLES OF BIOLOGY.*

BY HERBERT SPENCER.

Exposition of Part IV., Chapters XII. and XIV.

BY F. J. CULLIS, F.G.S.

To the evolutionist all things are as they are, simply because the natural forces to which they are and have been subject have been and are, such as could produce just this and no other result.

Mr. Spencer, in the fourth part of his Biology, shows this to be true of organic forms, and those of his pages in which he applies the doctrine to the morphology of plants have been

* Birmingham Natural History and Microscopical Society, Sociological Section, March 18th, 1886.

already discussed for us by Professor Hillhouse. A similar review of animal forms and the mode of their production and modification forms the subject of the chapters before us, in which it is shown that, in addition to those forces which modify the forms of plants, we have an important new factor in the locomotion which is so prominent a characteristic of animate life.

It is further shown that in animals which are rooted or fixed, and therefore subject to much the same conditions as prevail in the vegetable kingdom, we have that well-known resemblance to plant forms which the Sea Anemone has made familiar to our children, and which is so much more strikingly displayed by many of the compound Coelenterata.

Mr. Spencer reminds us that among the Protozoa, where an average all-round equality of conditions obtains, we have many instances of spherical form, which may be regarded as the Protozoon ideal, from which, without good cause being shown, it never departs; while in animals whose environment supplies an average equality of forces about an axis, we find a cylindrical or radial symmetry; and where the incident forces are equal and opposite on the two sides of a median plane, and there only, we get that bilateral symmetry which is so constantly and beautifully developed in all higher animal forms.

The radial symmetry of the Echinodermata having been justified by the evolution hypothesis, we read (p. 178):—

"On watching the ways of the common Sea-urchin, we are similarly furnished with an explanation of its spherical, or rather its spheroidal figure. Here the habit is not to move over any one approximately flat surface; but the habit is to hold on by several surfaces on different sides at the same time. Frequenting crevices and the interstices among stones and weeds, the Sea-urchin protrudes the suckers arranged in meridional bands over its shell, laying hold of objects now on this side and now on that, now above and now below; the result being that it does not move in all directions over one plane, but in all directions through space. Hence, the approach in general form towards spherical symmetry—an approach which is, however, restrained by the relations of the mouth and vent, the conditions not being exactly the same at the two poles as at other parts of the surface."

Passing on to higher forms, Mr. Spencer, speaking of the Annulosa (p. 182), says:—"The common Earth-worm may be instanced as a member of this sub-kingdom that is among the least conspicuously bilateral. Though internally its parts have a two-sided arrangement, and though the positions of its orifices give it an external two-sidedness at the same time that they establish a difference between the two ends, yet its two-sidedness is not strongly marked. . . . On calling to mind the habits of the creatures . . . it will be seen that they explain these forms. The incidence of forces is the same all round the Earth-worm as it burrows through the compact ground."

The forms of the Mollusca are next surveyed from the same point of view, and then the forms of the Vertebrates are considered. Mr. Spencer here shows that, as the front and hinder parts, and also the upper and lower parts of the higher animals are differently formed, so the conditions to which these unlike parts are subject are different. Moreover, such unlike parts are found to be more unlike in proportion to the degree of unlikeness in the conditions affecting them. And an illustration (p. 188) is found in the Pleuronectidæ—"the order of distorted flat fishes to which the Sole and the Flounder belong. On the hypothesis of evolution, we must conclude that fishes of this order have arisen from an ordinary bilaterally symmetrical type of fish, which, feeding at the bottom of the sea, gained some advantage by placing itself with one of its sides downwards, instead of maintaining the vertical attitude. Besides the general reason, there are specific reasons for concluding this. In the first place, the young Sole or Flounder is bilaterally symmetrical—has its eyes on opposite sides of its head, and swims in the usual way. In the second place, the metamorphosis which produces the unsymmetrical structure sometimes does not take place—there are abnormal Flounders that swim vertically, like other fishes. In the third place, the transition from the symmetrical structure to the unsymmetrical structure may be traced. Almost incredible though it seems, one of the eyes is transferred from the under side of the head to the upper side (p. 189) . . . . besides this divergence from bilateral symmetry involved by the presence of both eyes upon the upper side, there is a further divergence from bilateral symmetry involved by the differentiation of the two sides."

In a last quotation from a summary of the evidence (p. 189), we read:—"Thus little as there seems in common between the shapes of plants and the shapes of animals, we yet find on analysis that the same general truths are displayed by both. The one ultimate principle, that in any organism equal amounts of growth take place in those directions in which the incident forces are equal, serves as a key to the phenomena of morphological differentiation. By it we are furnished with interpretations of those likenesses and unlikenesses of parts which are exhibited in the several kinds of symmetry; and when we take into account inherited effects, wrought under ancestral conditions contrasted in various ways with present conditions, we are enabled to comprehend, in a general way, the actions by which animals have been moulded into the shapes they possess."

Wayside Notes.

Midland Geologists are to be heartily congratulated on the award of the medals at the disposal of the Geological Society of London for the year 1887. Two of these have fallen to the lot of Birmingham men, the Bigsby medal, given biennially, being awarded to Professor Charles Lapworth, LL.D., of the Mason College, and the Lyell medal, awarded annually, being appropriated to Mr. Samuel Allport, F.G.S., of the same College. The Bigsby medal has a rather quaint foundation deed. It is awarded "as an acknowledgment of eminent services in any department of geology, irrespective of the receiver's country; but he must not be older than forty-five years at his last birthday, thus probably not too old for further work, and not too young to have done much." This latter sounds rather like a delicate paraphrase of "not too old to be lazy, nor too young to be foolish;" but really the limit of forty-five years, as that at which men are liable to cease doing good original work, is a striking expression of the opinion Dr. J. J. Bigsby, F.R.S., had of himself and the majority of his most eminent compeers, and one which probably neither he nor they would be willing to accept the application of. Man's intellectual powers rarely reach maturity before forty; their decline must evidently be phenomenally rapid. However, we believe that Dr. Lapworth will have many years of good work before him when he has reached the Bigsby limit of forty-five. By the way, the Lyell medal carries a money grant with it of at least £25.

Men may come, and men may go, but the letters on Physiological Selection in the columns of "Nature" go on for ever.

We find that we have to welcome another "local Naturalist." The Essex Field Club has converted its transactions and proceedings into a monthly periodical called "The Essex Naturalist." We heartily wish it success. One of the main considerations which has caused the change is the desire which the society has to encourage inter-communication amongst its members, by promoting the contribution of personal notes of things of interest which have come under their observation. Readers of the "Midland Naturalist" could effectively brighten our own columns in the same way.

Motto for a Sportsman: "If you see a strange bird, shoot it." If you do not, probably someone else will, for this phase of the undying curiosity of man is well-nigh universal. How many rare birds, like the "hunting hawks," for instance, which have been seen with more frequency in recent years, would again settle down and become domiciled amongst us, could the gunners only be persuaded to leave them alone. But so deeply impressed is the principle that a bird in the cabinet is worth two dozen in the field, that protest seems hopeless. Will the time ever come when we can cease grieving over the needless destruction of rare birds, butterflies, or plants?

Petrologists will greatly miss the help of John Arthur Phillips, F.R.S., whose sudden death on January 5 removed one of their ablest thinkers. Mr. Phillips was more than a geologist; he could bring to bear upon geological problems chemical and mineralogical powers of the highest order. His work bore mainly on the practical side; amongst the mines of Cornwall or in the goldfields of California he was almost equally at home. But with, and above, all his scientific abilities, he showed kindliness, large-hearted sympathies, and simplicity in the most marked degree.

Mr. Herbert Spencer.—Naturalists interested in the synthetic philosophy will be glad to hear that Mr. Herbert Spencer has just re-published, with additions, in a small 8vo volume (pages I.-IV., 1-76), the two important articles which appeared under the title of "The Factors of Organic Evolution" in the "Nineteenth Century" for April and May last. The preface, which is dated "Brighton, January, 1887," and shows that the distinguished author is still at work, states, *inter alia*:—"Though the direct bearings of the arguments contained in this essay are Biological, the argument contained in its first half has indirect bearings upon Psychology, Ethics, and Sociology. My belief in the profound importance of these indirect bearings was originally a chief prompter to set forth the argument, and it now prompts me to re-issue it in permanent form."

METEOROLOGICAL NOTES.—December, 1886.

This month will be ever memorable in meteorological annals for the exceedingly low pressure on the 8th, when the mercury fell, at Loughborough, to 28·008 inches, and at Hodsock Priory to 27·861 inches. The fall was very rapid, the reading at Loughborough at six o'clock on the previous evening being 29·477 inches, and at six p.m. on the 10th it had risen to 29·392 inches. On the 31st, the reading at eight a.m. was 30·579 inches, giving a range which is seldom, if ever, attained in one month. Temperature was also very unequal. The mean was about five degrees below the average. The highest maxima were:—56·0° at Henley-in-Arden, 54·7° at Loughborough, 53·2° at Hodsock, and 52·5° at Coston Rectory, on the 6th. On the same date, in the rays of the sun, 88·1° was recorded at Hodsock, and 87·1° at Loughborough. The minimum readings showed an unusual degree of frost. The mercury fell to 12·0° at Coston Rectory, and to 17·4° at Hodsock, on the 18th; to 16·0° at Henley-in-Arden, on the 31st; and to 17·0° at Loughborough, on the 21st. At Hodsock, the thermometer on the grass registered 10·3° on the 18th, and at Loughborough 15·5°, on the same date. Rainfall was above the average. The amounts collected were 4·36 inches at Henley-in-Arden, 3·85 inches at Coston Rectory, 3·52 inches at Loughborough, and 3·51 inches at Hodsock. At Henley-in-Arden 1·20 inches was measured on the 26th. The number of "rainy days" varied from twenty-one to fourteen. Lightning was observed at Loughborough on the evening of the 18th, and lunar halos on the 3rd and 16th. Gales were of frequent occurrence during the month. Mock moons (*paraselenæ*) were observed at Coston Rectory, at five p.m., on the 1st.

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Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—General Meeting, January 18th. Mr. R. W. Chase in the chair. Mr. J. B. Williams, Secretary of the Toronto Natural History Society, exhibited the following birds, which he had brought from Canada:—The cat-bird, white-crowned sparrow, towhee bunting, and the scarlet tanager. Mr. W. R. Hughes, F.L.S., exhibited for Mr. F. W. Sharpus, of London, a series of twelve slides showing the anatomy of the spiders, including specimens from Australia, South Africa, &c. While the specimens were under the microscopes, Mr. Hughes explained the more interesting features; Professor Hillhouse, M.A., Mr. Pumphrey, and others took part in the discussion. Mr. J. E. Bagnall, A.L.S. exhibited *Vicia lathyroides*, from Hart's Hill, new to North Warwick. He then read a paper describing the mosses, &c., collected by Mr. J. B. Stone, J.P., from the Trosachs, Riviera, and other localities. He exhibited a fine collection of beautifully mounted specimens, and explained some of their peculiarities, and displayed their delicate structure by sections under the microscope. Amongst the many exhibited were the following:—*Hypnum Crista-Castrensis*, *H. fluitans* var. *submersum*, *Neckera crispa*, *Mylia Taylori*, *Bozzania trilobata*, and *Hypnum dilatatum*.—Geological Section. January 25, 1887; twenty-five present. Mr. W. P. Marshall, M.I.C.E., in the chair. The special feature of interest was a paper on "The Processes of Crystallisation in Rocks," illustrated by rock sections under the microscope, by Mr. T. H. Waller, B.Sc., who described the various processes of crystallisation which take place in molten masses of silicates on cooling. Beginning with ill-defined granules and heaps of granules, there gradually are built up very minute bodies which are not recognisable as definite minerals, but which show crystalline structure by their action in polarised light. These in some cases are seen to be aggregated into definite crystalline minerals of known species. The process of crystallisation in a rock has frequently gone on in two stages—the one before eruption, producing large crystals, the other afterwards, producing smaller ones. An interesting discussion ensued. After the paper had been fully discussed, a very hearty vote of thanks was accorded to Mr. Waller. A very fine geological map, the property of the Birmingham Natural History and Microscopical Society (date 1815), by William Smith, the "Father of English Geology," was exhibited. In February, 1831, the Council of the Geological Society of London honoured Mr. Smith by awarding him the first Wollaston Medal, "in consideration of his being a great original discoverer in English geology; and especially for his having been the first in this country to discover and teach the identification of strata, and to determine their succession by means of their embedded fossils."

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—December 20th. A meeting devoted to Geology. Mr. P. T. Deakin exhibited a somewhat large collection of fossils from the Lias and Inferior Oolite of Gloucestershire; Mr. Insley exhibited fossils from the Red Crag, and called attention to the conditions under which they were embedded; Mr. C. F. Beale, specimens of *Lepidodendron Sternbergii*, *L. selaginoides*, and *Lepidostrobus ornatus*; Mr. A. T. Evans, graptolites from the Lower Silurian; Mr. Madison, slates of Keuper marl, showing ripple marks and impressions of salt crystals; also specimens of *Helix labyrinthica* from Michigan. Under the microscope, Mr. J. W. Neville showed a section of coal-ball showing a sporangium with spores *in situ*.—January 3rd. Mr. H. Hawkes showed specimens of bramble brand, and remarked on the persistence of the fungus in the late severe weather; also the following fungi: *Agaricus fasiculatus* and *Auricularia mesenterica*; Mr. J. Madison, specimens of *Limnæa palustris*, *Bulimus hypnorum*, *Helix monodon*, and *H. alternata*, from America. Under the microscope, Mr. Hawkes showed *Œcidium thesii*; Mr. J. W. Neville, palate of *Zonites draparnaldi*.—Jan. 10th. Mr. C. Beale, C.E., read a paper on "The Stones of the Field." The writer referred to the great antiquity of the earth, the origin of language, and some of the earliest known references to stones. These references were made at a time when little was known concerning them, except their universality. Pretty and curious stones doubtless generated a desire in man to learn where such things came from. The writer described the manufactory of pebbles as the sea shore, and enlarged on the process of attrition by which they were brought to their rounded form. These forces were at work on every shore excepting those perpetually ice-bound. All pebbles were not, however, rounded in this way, for some owed their origin to mountain torrents. The writer described glacial action, and pointed out the difference in the deposits from those made by the agency of water. The wide distribution of stones was attributed to many causes—water, ice, and the agency of man—but the time necessary for it opened up a wide field for speculation, a period too vast for the mind of man to comprehend.—January 17th. Mr. J. W. Neville exhibited specimens of *Pelopæus fistularis*, a mason-wasp, from Constantinople; also, mouth organs of the same under the microscope; Mr. W. Tylar, a specimen of scorpion from Australia.

PETERBOROUGH NATURAL HISTORY, SCIENTIFIC, AND ARCHÆOLOGICAL SOCIETY.—January 11th, conversazione at Orton Hall, by the kind invitation of the Marchioness Dowager of Huntly. The magnificent billiard room was arranged as a concert hall, being prettily decorated with rare and interesting plants. A good musical programme had been arranged, and was well carried out by the various performers; while the Rev. E. Bradley, better known as "Cuthbert Bede," the author of "Verdant Green," &c., gave two excellent and highly amusing readings, and during the interval briefly alluded to Fotheringhay and Mary Queen of Scots, and the approaching tercentenary of her death. Refreshments, kindly provided by Lady Huntly, were served in the vestibule during the interval and at the close of the meeting, her ladyship, with her well-known kindness, doing her best to minister to the comfort and enjoyment of her guests. A magnificent collection of Roman, Saxon, and Early British vessels was exhibited by her ladyship, as also a collection of engravings of Mary Queen of Scots, and a part of the hangings, worked with the Scotch thistle, from the bed on which the Queen had slept. Mr. Bradley exhibited a miniature and contemporaneous painting of Mary Stuart; an impression from, and drawings of, the ring given by Darnley to the Scottish Queen, which was found at Fotheringhay a few years back, having, it is supposed, dropped from her finger on the morning of the murder, and been swept away in the bloody sawdust; also, several sketches and water-colour drawings made by himself of Fotheringhay and its neighbourhood, kindly presenting to the Society a pen-and-ink sketch of the chair preserved in Connington Church, from which Mary Queen of Scots is believed to have risen for execution; and water-colour drawings of a stone coffin *in situ*, found in the parish of Stilton, near to Folksworth, on December 24th, 1866. The length of the coffin lid was 6ft. 6in., breadth 2ft. 2in., with a thickness of 8 inches. Interior dimensions of coffin, length 6ft. 2in., depth 1ft. 5in., width of base 1ft. 2in., gradually increasing to a width of 2ft. There was also shown the (conjectured) route of Ermine Street; and Samian ware discovered on the site of the (presumed) Roman cemetery near Folksworth, one piece, the base of a patera, showing the potter's mark "BORILLIOFFIC;" and another picture showing ten fragments of pottery of different ware and markings, found in the field with the stone coffin recorded above. Hearty thanks were given to the Marchioness Dowager of Huntly, to Miss Goole, to the Rev. E. Bradley, and to other ladies and gentlemen who had assisted in the entertainment.—January 13th. Her Majesty the Queen presented to the Society, through Mr. C. Dack, copies of "Leaves from the Journal of our Life in the Highlands," and "More Leaves from the Journal of a Life in the Highlands." On the fly-leaf of each book appears, in Her Majesty's handwriting, the following inscription:— "Presented to the Peterborough Natural History, Scientific, and Archæological Society, January, 1887, Victoria R.I."

THE "MIDLAND NATURALIST."—At the meeting of the Management Committee of the Midland Union, held on the 24th of January, a letter from Mr. W. J. Harrison, F.G.S., was read, resigning the co-editorship of the "Midland Naturalist." Professor Hillhouse, M.A., F.L.S., was unanimously elected his successor. The hearty thanks of the Committee were given to Mr. Harrison for his past valuable services.

"CHANGE OF EDITORS.—During the past nine years it has been my pleasant though onerous duty to assist in issuing 108 numbers of the 'Midland Naturalist.' Since my coming to Birmingham, my associations have allowed me less and less time for the direct study of natural history, and I have more than once placed my resignation of the co-editorship of the 'Midland Naturalist' in the hands of the Council of the Midland Union, only withdrawing it at their assurance that I should be relieved as soon as a suitable man could be found to take my place.

"In now retiring from the post which I have held so long, it gives me special pleasure to know that Professor Hillhouse has consented to be my successor. To each and all of the supporters of this magazine I tender my hearty thanks for the consideration which I have always received at their hands. I shall always look back with pleasure at my connection with the 'Organ of the Scientific Societies of the Midlands,' and although no longer taking a direct part in its management, I shall still hope to contribute from time to time to its columns.

"W. JEROME HARRISON."

INDUCTION.

To the Readers of the "Midland Naturalist."

The Council of the "Midland Union of Natural History Societies" has asked me to undertake the responsibilities and duties of co-editorship, on its behalf, of the "Midland Naturalist." In acceding to its wishes I must at once candidly admit that I have been largely influenced by a desire to at least attempt to restore this magazine to its true position amongst scientific periodicals, by obtaining for it a larger amount of sympathetic assistance, whether in the form of contributions to its pages or of subscriptions, from the long list of Societies constituting the Union. It would be the merest affectation to assume that the present position of the "Midland Naturalist" is satisfactory, or that the journal itself is not susceptible of improvement. I hope its readers will not misunderstand me in saying that I should not have gone out of the way of my professorial duties merely for the purpose of preserving a *status quo*.

I believe that the "Midland Naturalist" has a real purpose in existence; that it does not more completely fulfil its purpose is not, however, the fault of its editors. What the "Midland Naturalist" offers to the societies constituting the Union is a means for the publication, the prompt publication, of such portions of their Transactions as it is desirable should be immediately published, or as are of interest sufficiently general to warrant publication. And this it offers without expense to the societies themselves. More than this, in its reports of meetings it gives an opportunity for local societies to publish such a diary of their proceedings as "Nature" gives to the learned societies of London, and this at a cost of no more labour than is involved in the secretary writing and sending the periodical notes.

No doubt the "Midland Naturalist" is small, and for its size perhaps some may think expensive. This again is a matter which can be rectified by others. Increase the number of the contributions, increase the number of subscribers, and the editors will gladly respond by increasing the size of the "Naturalist" to the extent the funds will allow. Indeed, if its pages were used by the societies constituting the Midland Union in the way in which they may and ought to be used, enlargement would become a necessity; though it need hardly be said that if both ends are to meet, as both ends must be made to meet, the members of the societies must help us by becoming subscribers in proportion as we help them by becoming publishers. It ought to be clearly and fully stated on behalf of the publishers, my co-editor, and myself, that there is no question of private profit in the ownership of the "Midland Naturalist." The only payments made on account of the magazine are towards the expenses of printing it; and an increase in the receipts from its publication would simply mean more money capable of being expended in the work of printing, illustrating, and distributing.

I would like local natural history societies to remember that they perform only one half of their functions if they live to themselves alone; that their labours to be of real value should also be communicated to others. A few of the societies constituting the Union, the more powerful and wealthy of them, recognise this, and are able to recognise this, by the publication of separate Transactions at more or less frequent intervals. The publication of Transactions is, however, an expensive matter, and the circulation very restricted; hence the great bulk of local societies, face to face as they are with small membership and low subscriptions, either do not publish at all, or publish at long intervals.

Now it is not too much to say that this tends strongly to kill local scientific activity. So long as a society is content to carry out the functions, very useful in their way, of a lecturing club, at which papers on general topics are read to such members as choose to attend the meetings, the method of non-publication will no doubt amply serve its purpose. But this alone is not the object with which local societies are founded. Nor is it fair to ask that labour of any value should be undertaken by a member for the very small return that the meeting can give him. With the judicious use of the columns of the "Midland Naturalist" the writer of a paper addresses himself to a far larger audience than could possibly come within the walls of a room many times exceeding the size of that in which the meetings of a society are usually held, and addresses them for the time future as well as the time present. I need hardly add that he does not thus in any way preclude, but rather facilitates, the subsequent publication of the paper, either in a separate form, or as part of the occasional Transactions of the society. Further, just as the publication of a paper enlarges the audience to which it is addressed, so the readers of the "Midland Naturalist," to whatever local society they may happen to belong, are placed upon a footing as it were of partial membership of all other societies from which contributions are received.

And even this is not all that the pages of the "Midland Naturalist" can do for its readers. It affords them a means, which it is earnestly hoped they will more freely avail themselves of, of recording natural history observations of local interest, and of the interchange of opinion, and of information, upon such scientific topics as come within its natural scope. For this purpose the editors will be glad to give admission to notes and queries, and to answers thereto.

These, then, are my own personal hopes in undertaking duties in connection with the "Midland Naturalist." They are hopes which are based upon a firm faith in the scientific and natural history resources of the Midland Counties; but it lies with others to demonstrate whether they are founded upon what is in itself a solid rock, or a shifting and unstable sand. If I cling to my faith in the rock, it is mainly because I am myself an outcome of a local natural history society; and it is impossible for me to think such dishonour of my scientific parentage as to believe that in the living present, and the yet unborn future, there are, and will be, in the ranks of the members of such societies less ardent lovers of scientific truth, than have existed in the past which daily fades from our touch. W. Hillhouse.

February 18th, 1887.

THE MIDDLE LIAS OF NORTHAMPTONSHIRE.

BY BEEBY THOMPSON, F.G.S., F.C.S.

PART IV.

The Middle Lias Considered as a Source of Water Supply.

(Continued from page 41.)

The Marlstone Springs.—The water which has supplied Northampton from 1848 to nearly the present time is derived from the Marlstone Rock-bed, and although satisfactory in quality, it is not so in quantity. I do not know what the average supply has been in recent years; but in 1871, when Northampton contained, according to the census, 45,080 people, the amount was 6·3 gallons per head per day (Haviland); and, although the available amount of water has been decreasing from the very first, still the supply to the town has once or twice been temporarily increased by deepening or making headings. Now, however, there is very little water left in the Marlstone. Many old wells are quite dry, and in all the water level is very low. As I shall have to refer to the Marlstone a good deal later on, it is scarcely necessary to say more here.

The Trias Springs.—After passing through the Upper, Middle, and Lower Lias in this district the upper part of the Trias is usually met with, and it has, in every case where it has been entered, yielded a supply of very salt water, the chief salts being the carbonates, sulphates, or chlorides of sodium, potassium, calcium, and magnesium. At the present time this salt water fills the old Kingsthorpe shaft to within 270 feet of the surface, which, assuming the pit has a depth of 967 feet, as the record gives it, means 697 feet of water. The nearest place where this water could find an inlet lies considerably to the north-west of the county, and well within Warwickshire, so that were it possible to use this supply, it seemed probable that it would be copious and fairly permanent. Pumping tests, however, showed that at Northampton it would only yield about 200,000 gallons per day,and at Gayton, where it stood twenty feet higher, less than 100,000 gallons.* The water at the Kettering Road well contained 1,200 grains of solid matter to the gallon, and the amount of Chlorine determined was 349·7 grains per gallon. That at Kingsthorpe and Gayton respectively was very similar, but each contained a rather larger percentage of solids.

The whole of the Trias has such frequent alternations of sand and marl that water may be obtained from it at very various horizons, and so it does not follow as a necessity that the water at Northampton and Gayton is from the same bed, though most likely it is.

It is known that the *Waterstones* of the Lower Keuper often yield an abundant supply of good water, and since the existence of the Trias had been proved by the trial shaft for coal at Kingsthorpe, about two miles to the N.N.E. of Northampton; when the Marlstone supply had got so low as to compel the Water Company to look for other sources, acting on the advice of their engineer, Mr. John Eunson, C.E., F G.S., and after consultation with Mr. R. Etheridge, F.R.S. and Professor Judd, F.R.S., they decided to make a boring to reach, if possible, the Waterstones, which their advisers thought might perhaps be reached within a reasonable distance from the surface. The boring was commenced from the bottom of a well previously sunk into the Lower

* "The Range of the Palæozoic Rocks beneath Northampton," by Henry Jno. Eunson, Esq., F.G.S. Quarterly Journal of Geological Society, August, 1884.

Lias, at a spot about 1 mile N.E. from the centre of the town, near the Kettering Road. Although the boring added much valuable information to the science of Geology, as is well known, it entirely failed in its object. After passing through 738 feet of the Lias (Upper, Middle, and Lower), some abnormal sandstones, and conglomerates, occupying sixty-seven feet six inches, were passed through, and then twenty-five feet of Carboniferous dolomite, and then Lower Carboniferous limestone and shales for a depth of twenty feet six inches, the total depth being 851 feet. The Trias, Permian, and Coal Measures were absent, though it was pretty evident the Upper Trias existed not far away, on account of the considerable influx of salt water below 800 feet. Mr. H. J. Eunson says, in the paper from which most of these particulars are taken, that, without doubt, the saline water came from the beds above the dolomite.

This was a perfectly legitimate and well-conducted trial, and I thought conclusively settled the matter of a deep-seated water supply for Northampton; therefore, when the Gayton boring was broached, and before the work commenced, at my own request I was given the opportunity of explaining to the engineer of the Company the reasons why I felt sure the undertaking must fail, at the same time to suggest the alternative scheme, to be explained later on.

It has been well known for a long time that in the South Midland Counties of England a series of ridges or folds of the older Palæozoic rocks extended in an east and west direction across the country, and even into Belgium, and at no very great depth beneath the surface, and that in most cases these rocks were capped by the cretaceous or newer formations entirely cutting out the lower Mesozoic formations towards the east, and the lowest of them towards the west.*

As I understood it at the time, the idea in going to Gayton, five miles south-west of Northampton, was to endeavour to get at the Trias between the ridges of these old Palæozoic ranges of hills, or on the flanks of them, but as I pointed out at the interview referred to, it was possible they might get lower beds than they did at Northampton, but still they would be only the upper beds of the Trias, because the lower ones would be those most eliminated by deposition in an area which had to sink considerably before any deposit

* More recent investigations show that "Oolitic" might be substituted for "Cretaceous." See "Nature and Relations of the Jurassic Deposits which underlie London, &c.;" by Prof. J. W. Judd, Q.J.G.S., November, 1884.

could take place on it. Thus the waterstones would not be present. These observations seem to be consistent with the result of the boring; the Rhætic shales were found, and some sixty feet of the Trias. They also seem necessary to explain the fact that further southwards at places where the Palæozoic ridge comes nearest to the sea level, newer and newer Mesozoic rocks rest upon it, showing that the ridge itself prevented the deposition of the earlier Mesozoic beds.

The anticipated thinning out of the Trias in the neighbourhood of Northampton, which was looked upon as an inducement to make a trial to reach the Lower Keuper waterstones, seems to offer no special advantages, but the reverse, because the thinning was only the result of an approach to a shore line of the early Trias sea.

It has been suggested that the carboniferous limestone met with at Northampton is an extension of the Pennine chain,* and I must admit that the finding of sixty feet of Trias at Gayton, five miles south-west of Northampton, and some 600 feet of Keuper marls at Rugby, some eighteen miles to the north-west, seem to favour the idea of a north and south extension of the carboniferous ridge, rather than an east and west one, in Northamptonshire. Still, the arguments made use of to account for the attenuation of the Trias, and the improbability of finding water, apply equally well; and the failure to reach the waterstones at Rugby constitutes a more powerful argument against success at Gayton.

Rivers.—With regard to a supply of water from the Nene, the water is not over-abundant, and is so polluted near the town, and the interference with mills and navigation likely to lead to such difficulties, that it was never seriously thought of.

Reservoirs.—At the present time a reservoir is being constructed in a valley near to the village of Ravensthorpe, for the supply of Northampton. It is situated about seven miles from the town, and is intended to hold 400,000,000 gallons of water. Before the reservoir was commenced, I did all I could to oppose its construction, both on account of its great cost and of the other drawbacks to such a supply for a town. I will not here make any specific charges against this scheme, because they might be misconstrued. I may even go so far as to say that if a reservoir there must be, then, providing there is enough water, the site selected could not be improved upon.

(To be continued.)

* "On the Range of the Palæozoic Rocks beneath Northampton." By H. J. Eunson, Esq., F.G.S. Quarterly Journal Geological Society, August, 1884.

THE DATA OF ETHICS.*

BY CONSTANCE C. W. NADEN.

"The Data of Ethics" forms the top-stone of Mr. Herbert Spencer's philosophy, or, at least, the highest stone yet placed; so that the Sociological Section of this Society, having but just completed the study of the "Principles of Biology," may seem unwarrantably to jump to a conclusion, by selecting this work for its next consideration. And yet, in making the leap, we do but follow the example set by Mr. Spencer himself. This book, which constitutes the first division of the work on the "Principles of Morality," with which the system ends, appears, the author tells us, out of its place, the second and third volumes of the "Principles of Sociology" being as yet unpublished. "The night cometh, wherein no man can work," is in substance the pathetic reason given for this departure from the natural order of precedence. This last part of the task it is to which the Synthesist regards all the preceding parts as subsidiary. "My ultimate purpose," he says, "lying behind all proximate purposes, has been that of finding for the principles of right and wrong in conduct at large, a scientific basis. To leave this purpose unfulfilled after making so extensive a preparation for fulfilling it would be a failure, the probability of which I do not like to contemplate, and I am anxious to preclude it, if not wholly, still partially. Hence the step I now take." Now, although as a section we may perhaps hope for that long life and strength which all of us must sincerely wish to Mr. Spencer, still it is natural that we should desire to touch and comprehend at an early stage of our studies what he regards as the vital point of his philosophy.

* An address delivered to the Sociological Section of the Birmingham Natural History and Microscopical Society, at the first meeting of the Section under the new laws of the Society, held at the Mason College, Birmingham, Tuesday, 22nd February, 1887. *(Transactions of the Society.)*

Having ascended the highest summit of the mountain range, we shall take our bearings, and shall be able to use the knowledge in subsequent ascents of the lower peaks or in excursions in the valleys.

That the problems which we are about to approach are important will be denied by none; but perhaps there are many who do not realise how transcendently important they are at the present stage of thought and belief. It is when the storms begin to beat, and the winds to blow, and the rains to fall, that it becomes foolish—nay, criminal—to be content with the very lordliest pleasure-house built on a shifting foundation. There is no time to be lost in looking out for a secure site; otherwise, great may be our fall. On this point I must again quote from the preface to the "Data of Ethics": "The establishment of rules of right conduct on a scientific basis is a pressing need. Now that moral injunctions are losing the authority given by their supposed sacred origin, the secularisation of morals is becoming imperative. Few things can happen more disastrous than the decay and death of a regulative system no longer fit, before another and fitter regulative system has grown up to replace it." This truth is strikingly illustrated by a passage from Ellis's "Polynesian Researches," quoted by Mr. Spencer in his work on "Ecclesiastical Institutions." It is as follows: "The sacrificing of human victims to the idols had been one of the most powerful engines in the hands of the government, the requisition for them being always made by the ruler. . . . An individual who had shown any marked disaffection towards the government, or incurred the displeasure of the king and chiefs, was usually chosen. The people knew this, and therefore rendered the most unhesitating obedience. Since the subversion of idolatry, this motive has ceased to operate, and many, free from the restraint it had imposed, seemed to refuse all lawful obedience and rightful support." Well, we are not South Sea savages, and our spiritual and temporal chiefs have not kept "the wretch in order" by condemning him to actual immolation at the shrine of an offended fetish. Still there have been modes always precarious, and now growing obsolete, of keeping the wretch who knew how to evade the laws in order, if not in very good order; and it is time to teach him that to be a wretch is bad evolutional policy. It is time for all of us to look to the basis of our moral creed, and to make sure that while beliefs may come and beliefs may go, morality must abide as an organic part of human nature.

It may at first appear a trifle incongruous that a Natural History and Microscopical Society should concern itself with Ethics. For surely the inhabitants of our ponds and hedgerows live "without a conscience," if not without "an aim;" surely the physiological conditions or concomitants of justice and mercy are not determinable by the most assiduous microscopist. Yet life in all its forms is the subject of Natural History; the simple conduct of the lowest organism is linked by a myriad gradations with the conduct of the highest; and until we understand those great biological generalisations, which are as true for the Amœba as for Man, we shall never truly comprehend any part of those sciences of mind and morals, which are themselves but sections of the science of life. "Just as, fully to understand the part of conduct which Ethics deals with, we must study human conduct as a whole; so, fully to understand human conduct as a whole, we must study it as a part of that larger whole, constituted by the conduct of animate beings in general."*

It is, indeed, chiefly in this breadth of foundation that Mr. Spencer's system differs from the empirical utilitarianism of Bentham and John Stuart Mill. All Utilitarians must, in the last analysis, estimate conduct by results. Conduct is good, if in the long run it promotes happiness; bad, if in the long run it decreases happiness. On this all are agreed; this is the common ground of Optimist and Pessimist; this, as Mr. Spencer shows, is virtually accepted even when verbally denied. Whether we estimate conduct by its relation to abstract virtue, to an ideal perfection of character, or to rectitude of motive; whether we invoke the Divine sanction, the legal sanction, or the sanction of conscience, our theory still involves an implicit reference to happiness as the ultimate end and aim. Theories differ by the varying degree in which they recognise the laws of natural sequence, and the interdependence of all departments of Nature. Empirical utilitarianism, for instance, takes no account of the established principles of biology, but seeks to confine itself to an induction which never can be complete. It is as though, declining to accept the law of gravitation, we were to insist on using Attwood's machine to prove experimentally the rate at which every apple falls to the ground. Attwood's machine is most useful for learners and as a means of verification, but there are a great many objects to which it cannot be applied, and physics certainly never would have become a science unless physicists had been willing to reason downward from law or

* "Data of Ethics," Ch. I., § 2

from hypothesis to phenomena, as well as upward from phenomena to law. This view is so important that I must quote Mr. Spencer's own words, contained in a letter to Mr. Mill :—"I conceive it to be the business of moral science to deduce, from the laws of life and the conditions of existence, what kinds of actions necessarily tend to produce happiness, and what kinds to produce unhappiness. Having done this, its deductions are to be recognised as laws of conduct, and are to be conformed to, irrespective of a direct estimation of happiness or misery. Perhaps an analogy will most clearly show my meaning. During its early stages, planetary astronomy consisted of nothing more than accumulated observations respecting the positions and motions of the sun and planets. . . . But the modern science of planetary astronomy consists of deductions from the law of gravitation —deductions showing why the celestial bodies necessarily occupy certain places at certain times. Now, the kind of relation which thus exists between ancient and modern astronomy is analogous to the kind of relation which I conceive exists between the expediency-morality, and moral science properly so-called."*

In this scientific and rational conception will be found the true answer to the objections so often and so forcibly urged against utilitarianism. It is repugnant to common sense and common feeling to assert that everyone is or ought to be at every moment consciously engaged in the pursuit of happiness, either for himself or for society. We know very well that many of our actions, although they may have pleasure as their impulse, yet have not pleasure as their conscious goal. "Every man acting voluntarily, does what he under all the circumstances prefers to do" is a perfectly true saying. But the seeming corollary, "he does it *because* he prefers to do it," is really ambiguous, and stealthily introduces a new and questionable idea. It is the seemingly innocent little word "because" which must bear the blame. For a confusion at once arises between the *final* cause and the *efficient* cause of the action; between the inclination which prompted it, and the object towards which that inclination was directed. My inclination prompts me to paint a picture or write a poem; but I do not take the inclination twice over, and make it into an object. My *object* is not satisfaction to myself, but the true expression of my thought. This expression will indeed bring me satisfaction, but I shall not work so well if I think very much about

* "Data of Ethics," Ch. IV., § 21.

the ultimate end. Not only are we apt to take the pleasure twice over, but we often take it three times over, confusing together the inclination, the object, and the results of the action. The results of my picture or poem, if it be good work, will be, let us say, beneficial to society; and yet benefit to society was not my object. In short, the *inclination* is always in the direction most pleasurable or least painful; the *results* of the action, if it be a moral one, are such as in the long run, and on a large scale, must increase happiness; but the *object* of the action need not be connected in the mind of the actor with any thought of happiness, personal or general.

Now it is the aim of rational utilitarianism to show, first, how inclination can be directed to an object not capable of gratifying any selfish desire; and second, how it comes that objects sought without any mental reference to general welfare are yet correlated with general welfare. Thus the way will be smoothed for a reconciliation of egoism, or care for self, with altruism, or care for others. I can but very briefly trace Mr. Spencer's solution of these problems.

(To be continued.)

THE RELATIONS BETWEEN EVERGREEN AND DECIDUOUS TREES AND SHRUBS.*

BY F. T. MOTT, F.R.G.S.

In the Highlands of Scotland there are four native trees which grow together nearly everywhere under similar conditions, of which two are evergreen—the Holly and the Scotch Fir, and two are deciduous—the Birch and the Rowan. What is the physiological difference? Why do the Holly and the Fir retain their leaves through the winter while the Birch and the Rowan drop them in the autumn? I do not know whether this question has ever been fully answered. I have not met with any satisfactory reply to it, and I offer the following notes as a contribution towards the solution of the problem.

* This paper originated from a discussion on the subject in Section D of the Leicester Literary and Philosophical Society, January 19th, 1887.

(1.)—Evergreen trees and shrubs are most abundant within the zone extending about 45° on either side of the equator, and having in no part of it, except on the mountains, a mean annual temperature of less than 50°. Within this zone, the evergreens form probably 80 per cent. of the total number of species, and in some parts of it a deciduous tree or shrub is scarcely to be found.

Deciduous trees and shrubs predominate in the zone, extending from about 45° to 60° of latitude, having a mean annual temperature of not less than 40°. Within this zone, they would constitute probably 80 per cent. of the total species if it were not for the Coniferæ, whose 200 evergreen species occur chiefly in this region.

(2.)—The whole of the Coniferæ are evergreen with the exception of the Larch, the Salisburia, and one or two others.

(3.)—A few species of trees and shrubs are evergreen in their native homes, but deciduous in more severe climates. as *Ligustrum Japonicum*, *Cotoneaster Simmonsii*, and some of the Cistuses.

(4.)—Certain orders, as Cornaceæ, contain some genera which are evergreen (*Aucuba*, *Garrya*, &c.), and others which are deciduous (*Cornus*). Many genera, as *Berberis*, *Viburnum*, &c., contain some species which are evergreen, and others which are deciduous; and some deciduous species produce evergreen varieties, as *Ligustrum vulgare*, var. *sempervirens*.

(5.)—There are about 3,600 known species of evergreen trees and shrubs, and about 1,200 deciduous species. About 75 per cent. of each bear showy flowers. Taking the whole 4,800 together, about 3,600 are shrubs and 1,200 trees.

(6.)—The hard cuticle of many evergreen leaves minimises evaporation, and their upper surfaces are often quite destitute of stomata.

(7.)—The young shoots of hardy evergreens in this country commonly remain green on one side, if not all round, throughout the winter, while those of deciduous species are mostly brown, plum-colour, or black.

(8.)—Professor Hillhouse, in a paper read before the British Association at Birmingham, has incidentally shown that deciduous leaves when they fall in autumn leave an accumulation of starch or other reserve food round the base of the dormant bud. This is not the case with evergreens. The chlorophyll-grains in evergreens leave the cell walls in winter and unite in central masses, but do not become decomposed as in deciduous leaves.

(9.)—Starch is only developed from chlorophyll under the influence of light. If it remains in contact with chlorophyll during prolonged darkness it is re-absorbed (*see* Sachs), but if it is stored away when formed in separate cells, as in seeds, tubers, &c., it continues unchanged.

Reviewing and collating these facts I suggest the following provisional theory :—

Whether any group or botanical order of trees or shrubs is normally evergreen or deciduous depends upon the climatal conditions under which it was evolved, differentiated and established as a distinct group; and the character then assumed is perpetuated by heredity through its later ramifications, although the climatal conditions may have changed considerably. But an order which was originally and is still normally evergreen may have evolved certain genera or species under later and much altered conditions, which assumed the deciduous character, and *vice versâ*.

An evergreen order is one which was evolved under a climate in which the change of seasons was but slightly marked. A deciduous order, on the contrary, originated under a climate in which the conditions of winter and summer differed widely.

The only extensive region of the earth, as it now is, in which the seasons are but slightly marked, is the tropical zone, and this state of things has existed probably for at least 100,000 years. But in earlier geological epochs, there is good reason to believe that the climate of the whole surface of the earth was much more equable than it is now, much more resembling the conditions of our present tropical zone. Evergreens, therefore, probably originated either in these early epochs, or else in the neighbourhood of the tropics. Of existing trees and shrubs, the oldest group is undoubtedly the *Coniferæ*. This order originated at least as far back as the Carboniferous period, and is normally evergreen, as might have been expected, with a few deciduous forms probably of late development. The earliest group of Angiosperms, the truly exogenous trees and shrubs, occurs in the Wealden formation, just before the opening of the great Tertiary epoch; and this group consists almost entirely of the curious evergreen order of *Proteaceæ*, now chiefly confined to the Cape of Good Hope and Australia.

In the lower Eocene strata are found, in addition to the Proteads, the evergreen Figs and Laurels; while the London clay yields also Anonas, Acacias, and Palms, all evergreen groups. Not till the Miocene period do such distinctly deciduous genera as the Willows, Poplars, Maples, Hazels, Birches, and Beeches make their appearance, and still these are in the minority, the forests evidently consisting mainly of evergreen forms. But from this period upwards the strata deposited in the temperate zone contain an increasing proportion of deciduous exogens, mixed with a few of the earlier evergreen forms, and the still persistent and evergreen *Coniferæ.*

The association of the deciduous habit with extreme variation of seasons is not difficult to explain. Leaves are the organs by which the functions of vegetable life are chiefly carried on. They are the principal organs of respiration, transpiration, assimilation, and secretion. By means of their form and position, large surfaces of sensitive tissue are brought into direct contact with air and light, but the necessary consequence is that they are, more than any other parts of the plant, liable to injury by violent changes of temperature, and especially by frost.

In regions whose mean annual temperature is above 55° snow does not lie and ice is rarely seen. The functions of vegetable life can be carried on throughout the year, although with diminished energy during the colder or drier periods, and the leaves of plants remain green and active until new ones take their place. But a mean temperature below 50° implies great depression in the winter months, and frequently severe frost such as the leaves of most plants are not able to bear. If they are killed while the cells are full of active chlorophyll, which has been providing daily food for the growth of the plant but has laid up no store, there will be nothing to support the fresh growth of spring, and the plant must dwindle or die. It would seem that by the law of natural selection and survival of the fittest, plants which were developed in climates gradually becoming more varied and more severe must have adapted themselves to these conditions by converting their chlorophyll into starch and storing it in special cells at the base of the buds as soon as the cold and comparative darkness of autumn began to check the vital functions. The leaves exhausted of chlorophyll would be of no further use and would be cast off, while the plant passed into a state of hibernation, withdrawing its remaining chlorophyll even from the surface of the young twigs, that it might be preserved for the time of re-awakening. This process is plainly analogous to the hibernation of animals in similar climates. Fattened by the abundant food obtainable in autumn, they are able to sleep through the season of cold and darkness, and to wake with a sufficient reserve to carry them on till fresh food is found. Deciduous plants are those which hibernate; and as some animals maintain themselves through the winter while others have acquired the habit of hibernation, so, even in the zone of frosts, some evergreen plants are mixed with the predominating deciduous flora; such species having perhaps been evolved in more moderate climatal conditions, but with organs and tissues so far differing from the majority as to be able to withstand some greater amount of seasonal variation.

A PROPOSED MIDLAND UNIVERSITY.

The English people are in the main so fully convinced that we have Universities galore, that the news that a movement has been seriously set on foot to further the foundation of a University for the Midland districts of England will probably come to most in the sense of a distinct shock. Why we think our supply of Universities should suffice fully for our needs, it is difficult to say. Seeing that Germany, with its unrivalled system of national education, has twenty-one such institutions, with over 22,000 students and nearly 2,000 professors and lecturers; seeing that Scotland, with its three and three-quarter millions of inhabitants (less than the population of London), has four Universities, with over 7,000 students, we can only conclude that if the English supply is sufficient for the English needs, it can only be because the English needs for University training are themselves small. But is this so? Have we not scattered over the length and breadth of the land local University and other Colleges, in which distinctly University training of a systematic kind is imparted to students counted by the thousand? And is not each of these a standing proof that there is a need in England for University training, and therefore there is a need, which the existing institutions do not fully supply, for English Universities? Perhaps it may be said that there is here a confusion of argument; that the grand upheaval of University Colleges which the last dozen years has seen is evidence of the need of University teaching, but no evidence of the need of University examination. This can hardly be; for in our methods of teaching the examination is an essential part, and every College recognises this in its own line of conduct, and every College gives, as the result of examination, certificates which only in degree differ from the examination certificate given by a University. The whole question, then, hinges on the power, not to examine, but to give some special distinction, as the result of examination, in the form of certain representative initial letters, B.A., M.A., and the like.

At the present time the bulk of these local Colleges send their candidates for these distinctive letters to the University of London. Why should they do this? Has the University of London any peculiar merits as an examining body which could not be possessed by any other body? This can hardly be, since the examiners of the University of London are themselves gathered from all quarters, and could become equally examiners in any other duly constituted examining body. Take the examiners of the University of London—and it must be distinctly understood that the University of London does nothing but examine—take the examiners of the University of London, and put them in another centre for examining purposes, and why should the result differ from that at present attained.? London is not an educational Mecca.

I suppose the fear really is that if there are a number of degree-giving bodies, the standard of degrees may be lowered. Well, to start with, what is the standard at present existing? Of course, this is uniformly high! Every educationalist will at once tell you that it is impossible, or well-nigh impossible, to conceive a more diverse system than that at present appertaining in England. Institute a comparison between a high honour degree and a "poll" degree at Cambridge. Both equally result in B.A. Compare London, again, with Durham; and add to these the personal University powers of the Archbishop of Canterbury, and what, then, must be our opinion of the uniformly high quality of the English degree-giving examination, or want of examination? The cry of lowering the standard of a degree is a farce; but it serves its purpose of making the English public fear a multiplicity of degree-giving bodies. It is quite true that a diversity of standard could exist, and might result from increase of the number of degree-giving bodies; but such diversity exists now, and could hardly be greater. Personally I much regret it, and probably nineteen out of every twenty educationalists do likewise; but it is absurd to suppose that the present disparity could be intensified. Further, every practical educationalist knows the value of each degree, so that he at least is not deceived. Nor do I think that, with proper addition of at least an equal quantity of external examiners to any local degree-giving body, very great disparity need exist; it would not surprise me, indeed, to find uniformity much greater than it at present is.

The movement in favour of a Midland University was originated about a year ago amongst the professorial staff of the two Birmingham Colleges—Mason Science College and the Queen's College Medical School, with the addition of the well-known Midland Institute. It has culminated at present in a memorial to the Mayor of Birmingham, which is as follows:—

"To His Worship the Mayor. Sir,—Many propositions have recently been made respecting the way in which it is desirable to celebrate the Queen's Jubilee. We feel that none of these entirely appeal to our sympathy. On such a special occasion it is well to leave the beaten track and to accomplish some public act which will for ever emphatically recall and emphasise the present year of our town's history. Birmingham, with its well-organised system of primary and secondary education, is yet far behind many other towns in the way of higher University education. We form the centre of a population larger than that of Wales, and nearly as large as that of Scotland, yet our youths have to go elsewhere for their degrees, and often for their training in science, medicine, and arts. Manchester and Liverpool have already their University, and Leeds will shortly follow in their wake. Are we to remain stagnant and alone? In Birmingham students have been prepared for obtaining degrees at distant Universities; but the work has been arduous and heavily handicapped by the want of a local body exercising University functions. The three institutions which we possess—the Mason College, the Queen's College, and the Midland Institute—are the products of individual public spirit. Those who are aware of their individual fitness know how little, both in the way of funds and of organisation, would be sufficient to found by their co-ordination a great Midland University, where our people could obtain that knowledge which means bread at their very doors, without having to go for it to Germany, to Scotland, or to London. We would suggest that that portion of the town's Jubilee Fund which it is decided to use for local purposes shall be converted into a University Fund, as an expression of the desire of the town to see in its midst a University which shall be in sympathy with the wants and requirements of the inhabitants, and shall rival the Victoria University."

Amongst those who have signed this memorial are the following:—Messrs. Follett Osler, F.R.S.; Richard Chamberlain, M.P.; H. W. Crosskey, LL.D.; E. F. M. MacCarthy, M.A.; Osmund Airy, M.A.; Professors Bridge, Poynting, Lapworth, Hillhouse, Haycraft, Heath, Sonnenschein, Dammann, Smith, Windle, Loreille, and Woodward, together with some fifty others.

The memorial has produced no direct result with the Jubilee Committee; nor probably did any one of the memorialists greatly anticipate such result. But it has set a ball rolling which will probably never stop till the Midland Counties, with their own special genius, their own special wants, and their special racial characteristics, have an institution in their midst endowed with the degree-giving function. The three counties into which Birmingham and its suburbs extends have a population of nearly two and a quarter millions—much more than half the population of Scotland. The eight counties impinging on these three, and forming the outer circle, have a population of another three millions. Why should students derived from this dense mass of population, taught and trained in its midst, go elsewhere for those examinations which are to crown their student career?

Perhaps it will take years to fulfil the hopes of the initiators of this University scheme for the Midland Counties. The ball has, however, been started; and for those amongst the readers of the "Midland Naturalist" who take an interest, whether for or against the scheme, I can only ask that they should purchase for a spare penny the presidential address of the Rev. H. W. Crosskey, LL.D., to the Birmingham Philosophical Society (Cornish Bros., Birmingham, publishers), and read there, given with an eloquence peculiarly his own, the reasons of one of the leading Birmingham educationalists in favour of this topmost stone of the Midland system of universal education. W. Hillhouse.

TWENTY-EIGHTH ANNUAL REPORT

OF THE

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY,

Presented by the Committee to the Annual Meeting, February 1st, 1887.

The committee in presenting the report for the year 1886 feel much pleasure in stating that the regular work of the Society has been well sustained. The communications made to the Society have been both numerous and valuable, and the specimens exhibited, whilst they have been very varied, have proved both interesting and instructive, many being very rare, and a goodly number being new to the district. This has been especially the case amongst the more minute forms of life, such as the micro-organisms shown from time to time by Mr. T. Bolton, F.R.M.S., the Society's assistant-curator; the micro-fungi by Mr. W. B. Grove, B.A.; to these must be added as a constant contributor, Mr. J. E. Bagnall, A.L.S., whose "Flora of Warwickshire" has won for him a high position amongst the local botanists of our country, and who from time to time has exhibited rare and interesting flowering plants, mosses, &c., with notes upon their geographical distribution. Still the committee believes that if a larger proportion of the members would bring specimens for exhibition, the interest of the Society's meetings would be yet further enhanced.

The committee are pleased to report that the diminution of members by withdrawal—owing to the increase in the subscription—has now practically ceased, and they look forward hopefully to an increase of membership in the early future.

On account of the visit of the British Association, no conversazione was held this year in the Town Hall; but each session was commenced by a soirée on a smaller scale, held in the examination hall of the Mason College, which was kindly placed at the disposal of the Society for that purpose.

The committee feel it an honour to point to the prominent part taken by many members of the Society, in the proceedings of the Meeting of the British Association in Birmingham in 1886, not only in the reading of papers before the various sections, and in their work on the different committees; but especially in connection with the Natural History portion of the Exhibition in Bingley Hall, and in their valuable help in the preparation of the "Hand-Book of Birmingham," which was published for the occasion. A resumé of the relations of the Society with the visit of the Association written by Professor W. Hillhouse, M.A., appeared in the "Midland Naturalist" for 1886, page 316; and the final report of the executive, presented to the general local committee, contains a generous and hearty recognition of the work of the Society in connection with the meeting of the Association.

The annual meeting of the Midland Union of Natural History Societies was held in Shrewsbury, on June 22nd and 23rd, when a conversazione was held in the Music Hall, and three excursions were made:—The geological to Norton and Stokesay Castle, the botanical to Ellesmere, and the archæological to Uriconium and Buildwas Abbey.

A whole-day excursion of the Society was made on Easter Monday, April 26th, to Chirk, when about fifty members attended. A fortnight's excursion was made to Tenby by a party of members of the Society, when the marine fauna and flora of the shore were examined, and botanical, geological, and ornithological rambles were made in the neighbourhood, and many interesting specimens found. Two excursions were made by the Sociological Section, and are referred to in the report of that section.

The committee deeply regret having to record the loss the Society has sustained by the death of Mr. John Morley, F.R.M.S., for ten years the active secretary of the Society, and to whose constant care it owes so much. His loss will be long felt by all who knew him, as his genial manner and readiness to help the members had won for him the esteem for all.

Another loss has also been sustained by the death of Mr. W. Southall, F.L.S., F.R.M.S., a former president of the Society, and one whose extensive botanical knowledge was often kindly placed at the service of the Society.

The committee have also to record the death of Professor T. Spencer Cobbold, M.D., F.R.S., an honorary vice-president, whose papers and exhibits on Helminthology have so frequently enriched the Society's Transactions; and of the Rev. W. W. Newbould, M.A., who has rendered very valuable service in the botany of this district, and whose specimens have occasionally been exhibited by Mr. J. E. Bagnall.

The total number of members is now 211, being a net decrease of 32. There are now six life members, 155 ordinary (guinea) members, twelve family (half-guinea) members, five honorary vice-presidents, thirty corresponding members, and three associates. The complete list of these will be separately published.

Transactions.—During the year there have been twenty-two general meetings of the Society (with an average attendance of 18·5), at which the following communications have been made:—

February 16th.—An enumeration of specimens of organic life, both animal and vegetable, found in a swampy ditch in Sutton Park: T. Bolton, F.R.M.S.

March 2nd.—Physical History of Great Britain from the Glacial epoch to the present day: Rev. H. W. Crosskey, LL.D., F.G.S.

March 16th.—Petrels and shearwaters of Great Britain: R. W. Chase.

March 30th.—Notes on a tour in America, including geology and natural history: W. P. Marshall, M.I.C.E.

April 6th.—Hints on photo-micrography: J. Edmonds.

April 20th.—A half day's ramble in the Arrow district: J. E. Bagnall, A.L.S.

April 20th.—Some observations on the anatomical structure of the Royal fern *(Osmunda regalis)*: Professor W. Hillhouse, M.A.

June 15th.—On the development and germination of the cocoa-nut *(Cocos nucifera)*: Professor W. Hillhouse, M.A.

November 16th.—Photographs of flowers and plants, illustrated by the oxyhydrogen lantern: C. Pumphrey.
November 30th.—Photo-micrography, illustrated by the oxy-hydrogen lantern: J. Edmonds.
December 7th.—A ramble amongst the lichens on the island of Bute: W. H. Wilkinson.

The following communication has been made to the Biological Section:—

On the mechanical structure of the hart's tongue fern (*Scolopendrium vulgare*): Professor W. Hillhouse, M.A.

The following communications have been made to the Geological Section:—

January 26th.—Fossil ornithology, with special reference to *Archæopteryx lithographic*, *macrura*: R. W. Chase.
May 25th.—The quartzite pebbles of the Drift: A. T. Evans.
July 27th.—On granites: T. H. Waller, B. Sc.
September 28th.—On the geological specimens collected in the Shropshire excursion of the British Association: W. P. Marshall, M.I.C.E.
October 10th.—On a rock from New Zealand, and the dust from the recent eruption there: T. H. Waller, B. Sc.
November 23rd.—The modern theory of glacier motion: W. P. Marshall, M.I.C.E.

The subjects of the meetings of the Sociological Section have been as follows:—

I.—The Principles of Biology.

January 21st.—Morphological differentiation in plants: Exposition by Professor Hillhouse, M.A., F.L.S. *(concluded)*.
March 18th.—Morphological differentiation of animals: Exposition by Mr. F. J. Cullis, F.G.S.
April 1st.—The vertebrate skeleton: Exposition by Mr. F. J. Cullis, F.G.S.
May 6th.—The problems of physiology: Exposition by Mr. W. K. Parkes.
May 20th.—Physiological integration in animals: Exposition by Professor Haycraft, M.B., F.R.S.E.
July 1st.—The laws of multiplication of organisms: Exposition by Mr. W. B. Grove, B.A.
October 7th.—The literature of Evolution published during the year: Address by Mr. W. R. Hughes, F.L.S.
November 25th.—Genesis, development, expenditure, and nutrition: Exposition by Mr. W. R. Hughes, F.L.S.
December 9th.—Special aspects of genesis: Exposition by Mr. F. J. Cullis, F.G.S.
December 16th.—Multiplication of the human race, and human population in the future: Exposition by Dr. Alfred Hill, F.I.C.

II.—The Studies in Sociology have been continued by Mr. A. Browett, Mr. W. H. France, Mrs. Browett, Mr. W. R. Hughes, F.L.S., Mr. F. J. Cullis, F.G.S., and Miss Naden.

Biological Section, (President, W. P. Marshall, M.I.C.E.; Secretary, J. E. Bagnall, A.L.S.)—During the year 1886, eight meetings of this section were held, with an average attendance of 14·25 members. The meetings have been mainly devoted to the exhibition of specimens, by which, and the discussions following thereon, their interest has been well sustained. Amongst the exhibitors, special mention has already been made of Mr. W. B. Grove, and Mr. J. E. Bagnall; the very beautiful ornithological specimens exhibited by Mr. Chase were made specially interesting by notes on habits, habitats, and other features of bird-life. Many specimens of North American plants, and mosses from various parts of Great Britain and the Continent have been exhibited from the collections of Mr. J. B. Stone, J.P., greatly enhancing the interest of the meetings. Mr. W. H. Wilkinson has exhibited many lichens and other plants; Mr. Fred. Enoch has exhibited and presented to the Society several beautifully prepared slides of insects and spiders; and other members have actively assisted in the work of the section.

Geological Section, (President, T. H. Waller, B. Sc.; Secretary, J. Udall).—Eight meetings of this section have been held during the year, with an average attendance of fifteen members. The section has to express its indebtedness to Mr. T. H. Waller, B. Sc., and Mr. Horace Pearce, F.L.S., F.G.S., for the exhibition of various rocks and volcanic dust from New Zealand, and of granites, and micro-sections of them, from Aberdeen and Peterhead; also to Mr. W. P. Marshall for the fine diagrams with which he illustrated his paper on "Glacier Motion," and to Mr. T. Evans for the exhibition of many beautiful specimens of fossils contained in the pebbles of the Drift.

Sociological Section (President, W. R. Hughes, F.L.S.; Secretary, A. Browett).—During the year twenty-one meetings of this section have been held, nineteen being ordinary meetings and two excursions. The average attendance at the former has been nine. The main subject of work has been the continuation, through Parts IV., V., and VI. of Mr. Herbert Spencer's "Principles of Biology." This important study was commenced by Dr. Alfred Hill, F.I.C., at a meeting of the section on October 4th, 1883, and was concluded by the same gentleman in an able and lucid address on the "Multiplication of the Human Race," and "Human Population in the Future" at the meeting on December 16th last. The exposition, discussion, and illustration of this division of Mr. Herbert Spencer's "Synthetic Philosophy" has given great gratification to those who have joined in it, and it is probably the first time that the systematic and combined study of a work on the principles of the doctrine of Evolution has been thus carried out by any Natural History Society. Eight chapters of the "Study of Sociology" of Mr. Spencer have also been read and discussed by the section during the year. The seventh excursion of the section was made on Saturday, July 24th, and under the leadership of Mr. A. Browett and Mr. W. Showell Rogers, LL.D., to "The Country of the Rev. Samuel Parr, LL.D.," Rector of Hatton, and to Temple Balsall, the ancient home of the Knights Templar and the Knights Hospitaller; and also to Wroxall Abbey, where the section was kindly received and entertained by Mr. J. B. Dugdale, J.P., and Dr. Rogers gave an address on "Dr. Parr: his literary works and influence." The eighth excursion was made to "The Country of Boulton and Watt," at Handsworth. The party first visited Soho House, where Matthew Boulton lived, and where the famous "Lunar Society" met. Mr. James Wilson, the present occupier, gave an account of the past and present history of the house. The party then visited Heathfield Hall, formerly the residence of James Watt, now of Mr. George Tangye, J.P., by whom the visitors were received and entertained. Here they examined the celebrated Watt Room, with its specially interesting contents; then after a visit to the parish church of Handsworth, the party was kindly received and entertained by Mr. and Mrs. J. B. Clarke, of Endwood Court, and a paper on the Watt Room was read by Mr. W. P. Marshall, M.I.C.E. The section regrets to report that Mr. Alfred Browett has resigned the office of secretary. The able, courteous, and energetic way in which he has carried out the duties of that office entitles him to the thanks, not only of the section, but also of the whole Society.

The Library.—(W. B. Grove, B.A., Librarian). The committee have great pleasure in announcing that in consequence of the publication on the monthly programmes of the Society of the list of books missing from the Library, several of the volumes have been found and returned. Two or three valuable works are, however, still missing. The issue of books during the past twelve months has been as follows: Botany, 40; Zoology, 19; Ornithology, 2; Entomology, 9; Geology, 15; Microscopy, 13; Philosophy and General, 47; total, 145. The number of persons borrowing books during the year has been 41. This does not fall far short of the number of 1885, and the Library is still frequently used during the day for the purpose of reference. The list of books added to the Library during the year will be separately published.

General Property.—The curators (G. M. Iliff and H. Miller), after a careful examination, have to report that the microscopes, &c., are in good condition. One of the oblique light diaphragms for the "Swift" sub-stage condenser is missing, also the paraboloid belonging to the same instrument, which latter they have been unable to trace since the opening meeting of the winter session in October last.

Finance.—The report and balance-sheet of the treasurer, (Chas. Pumphrey) which will be separately published, shows total receipts £172; total payments (including adverse balance of £37 17s. last year), £189 19s. 1½d.; balance due to the treasurer, £17 19s. 1½d. The total liabilities of the Society are about £83, the arrears of subscription being £15. Since 1861, upwards of £1,190 has been expended by the Society in books, furniture, and apparatus.

Review.

Florule Bryologique, ou Guide du Botaniste au Mont Blanc. Par Venance Payot. 8vo., pp. 78. Genève: Henri Trembley.

This little work, which gives the result of fourteen years' work and travel about Mont Blanc, the Pennine range, and circumjacent mountains, will be interesting and truly useful to those bryologists who have collected or intend to collect in this region of bryological wealth. Over 430 species and many varieties are recorded by the author, some of them new to science, and many of them rare. M. Payot had the advantage and honour of corresponding with that late great master of the science of bryology, Prof. W. P. Schimper, who examined the various species contained in his herbarium, and more recently the eminent botanists, M. L'Abbé Boulay, MM. Geheeb, G. Davies, Brotherus, Limpricht, etc., so that the nomenclature may be accepted as correct. The author's work is more than once alluded to in Schimper's Synopsis, and a rare moss, *Bryum Payoti*, was named in his honour by the author of that work, who says in commendation, "Unde oculatissimus *Payot* floræ m. Mont-Blanc investigator indefessus misit." The book is blemished by many typographical errors, some of which are corrected in the errata, but many still remain uncorrected; otherwise it is a valuable addition to our bryological literature.

J. E. B.

METEOROLOGICAL NOTES.—January, 1887.

Atmospheric pressure was very unsteady throughout the month. The mercury fell rapidly to 28·826 inches on the 5th, then rising quickly to the 13th (30·454 inches), after which it experienced various fluctuations. Its highest point was on the 21st. Temperature was above three degrees below the average. The means both of maximum and minimum were low. The highest readings were:—54·3° at Loughborough, on the 28th, and at Hodsock on the 29th; 54·0° at Henley-in-

Arden, on the 28th ; 51·9° at Coston Rectory, on the 30th, in the rays of the sun ; 93·0° at Loughborough on the 30th, and 92·9° at Hodsock, on the 29th. The lowest were :—10·0° at Henley-in-Arden, on the 17th ; 10·5° at Coston Rectory, on the 1st ; 12·3° at Hodsock, on the 7th ; and 14·4° at Loughborough, on the 17th ; on the grass, 4·0° at Hodsock, on the 7th ; and 13·5° at Loughborough, on the 17th. The amount of rain or snow (melted) was about the average for the month. A heavy fall of snow occurred on the night of the 7th, the values of which were 0.71 inches at Loughborough ; 0·60 inches at Henley-in-Arden ; 0·52 inches at Hodsock; and 0·39 inches at Coston Rectory. The total fall for the month was, at Henley-in-Arden, 2·61 inches ; at Loughborough, 2·44 inches ; at Hodsock, 2·30 inches ; and at Coston Rectory, 1·96 inches. A lunar halo was observed at Loughborough on the evening of the 10th. The last few days of the month were fine and warm. WM. BERRIDGE, F.R. Met. Soc.

12, Victoria Street, Loughborough.

Wayside Notes.

WE HAVE TO RECORD the loss to science by the death of one of our veteran workers in bryology, William Curnow, who died January 24th, 1887, at his residence, Newlyn Cliff, Cornwall, aged 78. Although Mr. Curnow published little, his work in the mosses and hepatics has been extensive, and his name is one honoured not only in Britain, but also on the Continent. He contributed many specimens of the Hepaticæ to the "Fasciculi," issued by Carrington and Pearson, as well as to those issued by Continental botanists. Among his published works may be mentioned his paper on "The Hepatics of West Cornwall," by William Curnow, and "The Mosses of West Cornwall," by William Curnow and John Ralfs, M.R.C.S. These were both published in the Transactions of the Penzance Natural History and Antiquarian Society.

SOME new species of rotifers, twenty-four in number, are described and illustrated in the February number of the "Journal of the Royal Microscopical Society," by P. H. Gosse, F.R.S. Amongst these four came from the neighbourhood of Birmingham, collected by Mr. Thomas Bolton, the indefatigable Assistant Curator of the Birmingham Natural History and Microscopical Society. They are—(6) *Diaschiza (?) cupha*, a hunchbacked form described from a single dead specimen in water from Birmingham. (8) *Pterodina reflexa*, found abundantly in water from Smallheath. (12) *Notholca polygona*, characterised as a remarkable species, and found in Kingswood Pool ; and (18), *Asplanchna eupoda*, a species with a remarkable foot, found in the canal at Small Heath. Next month we will copy Mr. Gosse's descriptions of these new local species.

A DEPOSIT of phosphatic nodules, the so-called "coprolites" of commerce, has been found in the Isle of Wight by two assistants in the Woodwardian Museum at Cambridge, Messrs. Keeping and Woods. They are in four beds, in distinct horizons, the lowest about 200 feet from the top of the lower greensand, and one of them thick enough to work, but for the fact that the beds dip at such a high angle that little could be profitably extracted. These pseudo-coprolites have been worked for many years at several places in Bedfordshire, *e.g.*, Leighton Buzzard, Woburn, Ampthill, Sandy, and Potton, going right across the country, and following the base of the upper neocomian greensand. There the beds range from six inches to two feet in thickness. In Cambridgeshire, where they are likewise worked extensively, they come either from the gault or the lower greensand. In Suffolk they are met with at the base of the Red Rag, and probably derived from the Coralline Crag. They are very interesting deposits, partly the débris of denuded beds, partly bones of dead saurians and fish, but all rolled about in shallow seas, till their identification becomes very difficult. True coprolites of fæcal origin were first found in the lias of Gloucestershire, but never occur in quantity sufficiently great to make them of value for agricultural purposes.

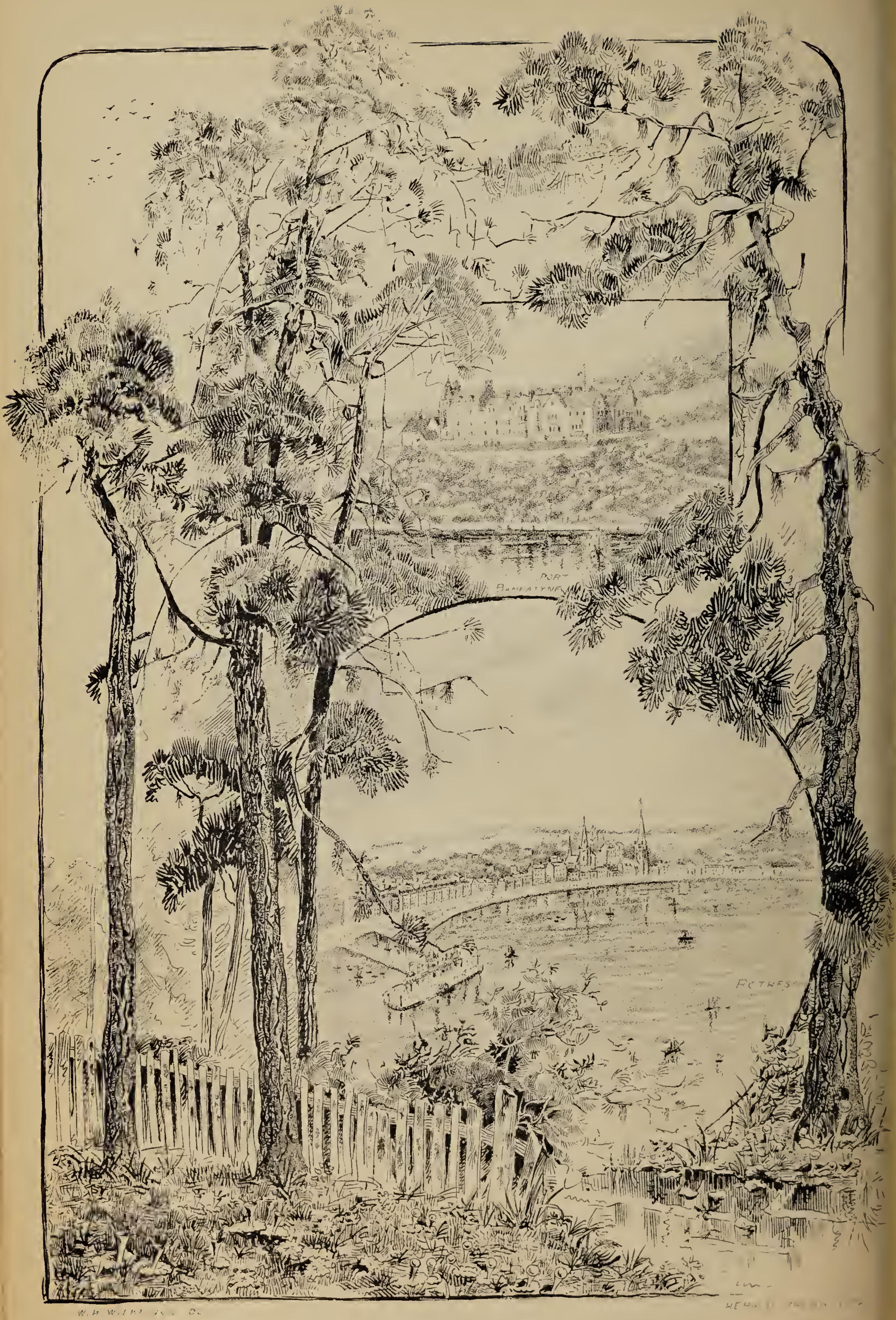
Pulicaria dysenterica, *Gaertn.*, var. *longiradiata.*—Last autumn I noticed on Bowar's Hill, Berkshire, a form of *P. dysenterica*, which differed considerably from the usual state in having the ray ligules narrow strap-shaped, half an inch long The flowers of the disc were normal and fertile, nor did the plant in habit differ from the type. This variety does not appear to have been noticed in our own or Continental floras. The figures of the plant, too, represent it as having a short contiguous ray. Sir J. D. Hooker considers it a handsome form. Should the character be constant in cultivation, it, however, would appear to be at least worth varietal distinction, and the above name, although rather uncouth, has at least the merit of describing its special feature. [G. C. Druce, Oxford.]

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—February 1st, Annual Meeting. Mr. R.W. Chase presided, and there was a good attendance of members. The report for the past year was read by the hon. secretary (Mr. W. H. Wilkinson), and an abstract of it appears at page 70. On the motion of Professor Hillhouse, seconded by Mr. W. R. Hughes, the best thanks of the society were cordially presented to the president (Mr. Chase) for his services during the past year. Similar votes were accorded to the officers and committee, and to the local press. Professor Hillhouse was elected president of the society for the forthcoming year; Mr. W. B. Grove and Professor Lapworth, vice-presidents, together with four ex-presidents ; Mr. Pumphrey, treasurer ; Mr. W. H. Wilkinson and Mr. W.P. Marshall, general secretaries ; Mr. J. E. Bagnall, librarian. The committee was also appointed, and some changes were made in the society's laws. Professor Hillhouse, in taking the presidential chair, said he regarded it as a happy augury that that great scientific college in which they were assembled had now two of its professors occupying the presidential chairs of the two great scientific societies of Birmingham.—Biological Section, February 8th. Mr. R. W. Chase was elected president of the section, and Mr. W. P. Marshall was elected secretary for the ensuing year. Mr. J. E. Bagnall read a paper on "South American and European Mosses," describing several genera of South American mosses, and giving notes of their distribution in America and in Europe. The paper was illustrated by specimens, together with micro-preparations, to show their structure ; also a series of Italian mosses was exhibited from Dr. Bottini, of Pisa, including *Hypnum Bottinii*, *Grimmia Lisæ*, and *Bryum juliforme*. Mr. T. Clarke exhibited specimens of silicified wood from Chalcedony Park, in Arizona, North America. It was arranged, on the proposal of Professor Hillhouse, to hold supplementary meetings of the section for the study of special biological subjects; the first series of these is to be devoted to the Mosses, and the first meeting will be held on Friday, 25th inst., when the subject will be taken by Professor Hillhouse of "Mosses and their Life History." This will be continued at a second meeting in March, after which Mr. J. E. Bagnall will undertake the "Classification of the Mosses." — SOCIOLOGICAL SECTION, February 22. There was a large attendance, including many ladies. Mr. W. R. Hughes, F.L.S., was unanimously re-elected president, and Mr. F. J. Cullis, F.G.S., hon. sec. Thanks were passed to Mr. A. Browett, the retiring hon. sec., for his able and courteous services. Miss Naden then delivered a most interesting address on Mr. Herbert Spencer's "Data of Ethics," the aim and scope of the work. The first portion of the address appears at p. 59 of this month's "Midland Naturalist." A cordial vote of thanks was unanimously passed to Miss Naden for her able and valuable address.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—January 24th. Mr. T. H. Waller delivered a lecture on "Inclusions in Crystals." The lecturer described the consolidation of igneous rocks, and how largely the resulting rocks depended on the rate of cooling. In a molten mass everything was ready to combine; as the temperature fell, oxides crystallised out first and silicates next, forming olivine. As the olivine was drawn together it often shut in magnetic grains and crystals, although it sometimes pushed them out, forming crowns of them on the outer sides. There did not always seem to be a definite order in crystallisation, for augite was sometimes included in felspar, at others felspar was included in the augite. The lecturer spoke of the curious arrangement of some crystals, and said that while some were readily determined, others, like quartz, were of an arbitrary character. A description of the manner in which air and water cavities found their way into rocks brought the lecture to a close. The subject was largely illustrated by rock sections under the microscopes.—January 31. Mr. A. T. Evans showed pebbles from the Moseley Drift, containing burrows of *Trachyderma serrata*, impression of spirifer, part of trilobite, calymene, etc. Mr. P. T. Deakin, specimens of fossil wood from the lias of Dorsetshire.—February 7th. Mr. W. Dunn exhibited a curiously constructed nest of a species of weaver bird taken from an orange tree in India, also a scorpion from the same locality. Mr. J. Madison, specimens of *Pisidium amnicum*, from several localities in the neighbourhood, a shell said not to be found in the district; Mr. Deakin, a distorted specimen of *Unio pictorum*. Under the microscope, Mr. J. W. Neville showed striated muscles in *Pulex irritans*.—February 14th. Mr. A. T. Evans showed pebbles from the Drift, containing gena and tail of a trilobite and other fossils. Mr. W. Tylar then read a paper on "Photography as an adjunct to the study of Natural Science." The writer glanced at the early history of photography, and described many of the difficulties it passed through, and that it only rose to an art when Mr. Fox Talbot found out a method of fixing the pictures. The main portion of the paper was taken up in describing the many ways in which this art had rendered service to science. The paper was illustrated by a lantern exhibition of photographs, and comprised photo-micrographs and an assortment of other slides; a series of slides of orchids and of plants covered with hoar frost being specially deserving of mention.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY. —Section D, Zoology and Botany. Chairman, F. T. Mott, F.R.G.S. Evening Meeting, January 19th; attendance, eleven (five ladies). The Chairman exhibited some charred wheat found by Mr. Ingram, of Belvoir Castle, in an ancient British granary dug in the ground near Belvoir, and read a short article by Mr. Worthington Smith, which appeared in the "Gardeners' Chronicle," comparing various examples of old British wheat found in similar granaries, with the wheat now sold in English markets, and concluding that in size of grain there was no conspicuous difference. The Chairman suggested that probably, however, there would be a considerable difference in the length of ear and number of grains, and pointed out that in the wild *Ægilops*, from which wheat was supposed to have descended, the number of grains was very small in each ear.—The subject for discussion was "The relations between evergreen and deciduous plants." The Chairman exhibited a number of twigs of each kind, showing that in evergreens these were usually more or less green even in winter, while in deciduous trees and shrubs they were mostly brown or blackish. He believed that the physiological difference related to the storage of reserve food material, and depended largely upon the climatal conditions under which each species had been evolved. Rev. T. A. Preston, M.A., gave an interesting account of the elaborate phenological observations which he had carried on at Marlborough for about twenty years, and exhibited several large and valuable diagrammatic tables, showing some of the remarkable results obtained by a comparison of the average temperature, rainfall, and sunshine, with the date of flowering of a number of wild plants.—Evening Meeting, Feb. 16. Attendance 10 (three ladies). The following objects were exhibited, viz., by Miss Sloane, two specimens of Leicestershire plants from districts in which they are not recorded in the new County Flora. By E. F. Cooper, F.L.S., a collection of the seeds of grasses and other plants neatly put up in glass tubes, labelled, and arranged in trays. By Rev. T. A. Preston, M.A., a valuable diagram showing the daily amount of sunshine for every day in the year 1882; also two curious hygrometric plants, a Selaginella and "The Rose of Jericho," from the desert districts of Asia, which although apparently dead and juiceless, opened out when placed in a dish of water. Also two specimens of the "Globe Conferva," *Conferva ægagropila*, each about 1½ inch diameter, and a ball of fir-leaves five inches in diameter, all from the famous Shropshire lakes. By the chairman, one of Baker's Dissecting Microscopes, with which several of the younger members had a little practice in dissecting vegetable tissues. The chairman then introduced a discussion on "The Biological Meaning and Action of a Stimulant," which was well maintained by Dr. Tomkins, Dr. Cooper, Rev. T. A. Preston, Mr. E. F. Cooper, Mr. Overton, and Mr. Garnar. The problem to be solved was whether organic "stimulation" implies the release of potential energy, or the imparting of kinetic energy, or a combination of both, or some action not referable to the known laws of energy. The phenomena of stimulation by mechanical blows or friction, by radiant or conducted heat, by the prick of a needle, by galvanism, by food, and by camphor, ginger, alcohol, and opium, were all considered. The discussion was interesting and instructive, and it was felt that the problem was at present by no means ripe for solution.



THE LICHENS OF THE ISLAND OF BUTE

A RAMBLE AMONGST LICHENS IN THE ISLAND OF BUTE.*

BY W. H. WILKINSON,

HON. SEC. OF THE BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.

In this paper your attention is invited to some of the results of a ramble amongst the lichens.

The flowering plants ever offer special attractions, with their beautiful forms and brilliant colours; the ferns have won for themselves a place in the garden and the home from their graceful fronds and their association with shady woods and holiday joys. The mosses, too, have a charm all their own, and although but seldom cultivated they, by their abundance in decorating every wall and tree and crowding over each space of unoccupied land, are familiar to every observant eye. The fungi also have received a good share of attention at the hands of the students of botany, which has yielded a rich harvest of interesting facts to the world at large.

But the lichens are so low down in the scale that they are generally overlooked, or meet with but scant attention. Yet they have a useful purpose to serve, and form a link without which the chain of Nature would not be complete.

The lichens are separated into two divisions—viz., the lower or crustaceous, and the higher, including the foliaceous, fruticulose, and filamentous.

The crustaceous generally grow on rocks and stones, and sometimes on trees, moss, &c. Starting from a central point they form somewhat circular or oval patches on the rocks, and year after year they not only extend outwards but they increase in thickness, and thus sometimes they live to a great age.

Description of Plate I.

View of the Kyles of Bute Hydropathic Establishment, Port Bannatyne.

View of Rothesay Bay.

The Lichens represented are—

Usnea barbata on trees.
Peltigera canina in foreground.
Cladonia pyxidata, "The Cup Moss."
Cladonia digitata, var. macilenta, scarlet fruited.

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* Transactions of the Birmingham Natural History and Microscopical Society. December 7th, 1886.

The higher lichens, on the other hand, grow into the form of miniature trees and shrubs, or spread into various leaf-like forms, and are found abundantly on trees, rocks, and walls; also on moss and on the ground. And it is to these (the higher lichens) we wish to confine attention for the present paper, so in order to give definiteness to our remarks we will endeavour to describe a real "ramble amongst the lichens," and that in one of our favourite haunts—viz., the western islands of Scotland.

An hour's ride by the fast train will take us from Glasgow to Wemyss Bay, where a pleasant-looking steamer is waiting to convey us on to Rothesay, the chief town on the Island of Bute. On the passage we notice the fine views of the coast line at the mouth of the Clyde and the Islands of Comrie and the sharp peaks of "Goat Fell" and other mountains on the Island of Arran.

After landing on the spacious pier at Rothesay we find a tram-car waiting, which takes us round the bay some two miles northwards to Port Bannatyne, where we stop for our head-quarters. The view from here is quite charming, as in clear weather the mountains across the Kyles of Bute appear in sharp outline, and the fleet of gentlemen's yachts at anchor in the bay below, with the sun lighting up their flapping sails against the deep blue water, altogether forms a beautiful picture.

Being prepared with tools to obtain and vasculum to carry our pretty plants, we set off for our ramble. The first part of our course is a walk round Kame's Bay, where our attention is at first caught by the fine scenery which surrounds us; but standing on the stones just above high-water mark to get a vantage point of view, we at length glance down to the stone on which we were standing and find its sides brilliant with the golden yellow of a lichen, and stooping down we find it to be *Physcia parietina*, the wall lichen, one of the brightest and commonest of them all, as it is found everywhere—on rocks and trees, on tile roofs, and wood palings. We notice plenty of it on the stone wall we are passing, and a little further on we come to a variety of it on a tree, called *P. polycarpa*, the thallus or leaf-like portion being green or greyish instead of yellow, while the little discs or apothecia are still of the same orange colour, and both kinds are white underneath.

Leaving the bay we enter a small "glen," winding up Kame's Hill, evidently worn out of the hill side by the tiny "burn" rippling pleasantly along our path. The glen is lined with trees, affording a pleasant shade from the sun and a shelter from the cold and stormy winds. We notice the grassy banks beneath the hedges or palings, and on stopping to look into it we find growing amongst the moist grass a rather larger lichen *Peltigera canina*, of a deep olive green above and almost white beneath, but we find it pretty firmly attached to the grass by a number of white rhizinæ or root-like appendages, which are not really roots, but are evidently only means of support, like the tendrils of climbing plants. From the edges of the thallus finger-like lobes may be seen standing upright, upon the ends of which are flat round discs of a dark brown colour. These are the apothecia, and bear the asci and spores. When dry the plant looks very different in colour ; the olive green all disappears, and the thallus goes into a light brown or grey colour.

If we now notice the trunks of the trees we find them abundantly mantled with a whole galaxy of lichens. Let us look more closely at some of them.

There is the grey beard-like *Usnea barbata*, of a pale sea-green shade, with its long threads growing into tangled tufts; through the centre of each runs a white thread, being the medullary layer ; a whitish powder, the soredia, is often scattered over the fine branches, which gives a very soft appearance to the plant, thus much heightening its effect in ornamenting the forest trees. Its fruit is terminal, and the disc is surrounded with a row of barbs; hence its name *barbata*.

Near it we find a somewhat similar lichen, but much firmer in texture, *i.e.*, cartilaginous. Its branches are flattened, and not so fine nor so intricate as in *Usnea*, but they, too, are often extensively covered with patches of mealy soredia, which give the name to it—*Ramalina farinacea*, and it is very rarely found in fruit.

Near it there is another of the same genus—*Ramalina fastigiata*—which is abundantly in fruit, and, as its name implies, it is a small variety with a number of short branches closely packed together.

Our attention is next arrested by a whole cluster of very pretty, though rather shaggy-looking lichens, almost covering the branches of a tree. This is *Evernia prunastri*. Its soft limp thallus is flat and cut into a number of branching lobes, called laciniæ. It is glaucous on one side and snowy white on the other, and is one of the most plentiful lichens on the trees of our woods and the palings of our country lanes.

There is another *Physcia* growing on the trees, but it is so near the colour of the bark and is so closely appressed that you will have to go close up to find it. The centre is often crowded with the little cup-like apothecia, while both they and the thallus are covered with a fine powder. Hence its name—*P. pulverulenta*.

On another tree we find *Physcia stellaris*, var. *tenella ;* it is of a grey colour, and has long cilia from the edges of its laciniæ.

We now come to a whole group of parmelias, the most conspicuous of which is *P. caperata*, wrinkled in the centre, rounded lobes on the margins, closely oppressed, and of an ochroleucous colour. Then a patch of *P. perlata*, of a greyish glaucous colour above and brownish-black beneath. Next we find, quite close to the bark, a specimen of *P. olivacea ;* as its name indicates, it is of a deep olive brown colour, but it is only found by close examination, as its dark colour so nearly assimilates to that of the tree.

We now come to *Parmelia physodes*, one of the commonest of all our British lichens. It grows nearly everywhere, but here we find it abundantly on the trunks of trees, and in places almost covering the wayside palings. It is of rather a stiffish texture, of a whitish glaucous colour, and pitch black below. It is very various in the shape of the lobes of its thallus, sometimes being rounded at the apices, at others inflated, and sometimes formed into little horns open at the mouth and marked with a white soredia at the extremities. The whole of this group of parmelias is very seldom found in fruit, but high up the glen we found this one, *P. physodes*, with its cup-like dark brown fruit, and some specimens thickly covered with the spermogones, which may be recognised as minute black points on the surface of the thallus.

And the last of this group is *Parmelia saxatilis*, which we find plentifully mixed with the preceding on trees and palings. It is of a greenish colour, and black fibrillose below; it may usually be distinguished by its surface being reticulated or marked by fine cracks. We also find here its two varieties—*sulcata*, in which the soredia appears in lines, with the edges of the ruptured thallus thrown up on each side of it; and *furfuracea*, in which the centre is covered with points, or, as it is called, isidiose; and on the rocks near we find a third variety of a dark olive colour, *P. saxatilis*, var. *omphalodes*.

We now emerge from the wooded glen on to the top of the hill, and the fresh mountain breeze is welcome and refreshing after our scramble up the valley; having admired the wide panorama that presents itself on all sides of us, we look amongst the grass and boggy ground, and find ourselves introduced into the group of Cladonias. Here is the familiar "cup moss," as it is called, *C. pyxidata*; then the beautiful scarlet fruited *C. digitata*, var. *macilenta*; then the quiet brown *C. cervicornis*; then we find the hollow tubes of *C. uncialis* opening out into four points at the tops of their stems.

Plentifully scattered all round us we find the *Cladina rangiferina* and *C. furcata* looking like miniature trees, but with hollow stems and bending over at the extremities, bearing the brown fruit, like tiny berries, hanging from their points.

We also notice amongst it portions of *Cetraria aculeata*, with its wire-like brown stems, angular, and often spinose on the margins. Then on the rocks which crop up here and there, amongst many old friends, we find *Platysma Fahlunense*, with its dark brown lobes often curling up on its edges, and sorediiferous. Then, lastly, as we must hasten homewards, we find on the earth, sheltered by the heather, *Bæomyces rufus*, a delicate green thallus, bearing on its white stipes the capitate reddish apothecia.

Thus, in one single ramble, we have met with most of the Common Lichens which enrich our hedge banks and ornament our trees. And it is these which the young student would first wish to know; the Crustaceous ones and the rarer species will form subjects for his future investigation.

We trust our introduction to this group of lowly plants will awaken an interest in their study in the minds of some, and be a slight help to enable us to know more of the variety, the beauty, and perfection in the manifold works of the Creator.

HISTORY OF THE COUNTY BOTANY OF WORCESTER.

BY WM. MATHEWS, M.A.

The Authors of the best local Floras of modern date have deemed it a useful and honourable task to trace the history of the discovery of the indigenous vegetation of the districts upon which they have written, and to describe the successive contributions made by their predecessors to our knowledge of the present day. This task has not yet been adequately performed for the County of Worcester. I have ventured to attempt it and hope, by so doing, to lay the foundation for a new Flora of the County, whenever, and by whom, it may be undertaken.

A fairly complete list of the writers who have published records of Worcestershire plants is contained in the "*Botany of Worcestershire*" (Worcester, 1867), by my friend Mr. Edwin Lees, p. lxxxviii.—xci.; and also, under the head of Worcester, in the "*Botanical Bibliography of the British Counties*," by Dr. Henry Trimen; Journal of Botany, 1874, Vol. XII., p. 155. It should further be mentioned that the late Rev. W. W.

Newbould, who was associated with Mr. J. G. Baker in the editorship of the second edition of Watson's "*Topographical Botany*" (London, 1883), searched, with characteristic industry, all the early Floras and made notes of the records referring to each county. These notes are contained in a number of manuscript books which are happily preserved in the Botanical department of the Natural History Museum at South Kensington. I have derived great assistance from them.

Our history may conveniently be divided into four periods. The first, from the date of the earliest records up to the middle of the 18th century; the second and third, the second half of the 18th and the first half of the 19th century; the fourth, from 1850 to the present date.

First Period. Up to 1750.

The first writer whose name has been mentioned in connection with Worcestershire Botany is John Leland, the Antiquary. His Itineraries began in or about the year 1538, and are described in a manuscript preserved in the Bodleian Library. A copy in black letter was published by Johan Bale in 1549. An edition in nine volumes was published from the original MS. by Thomas Hearne (Oxford, 1710—12), and a second edition of the same in 1744—5.*

At page 138 of Mr. Lees's Botany of Worcestershire is the following foot note :—

"*Leland, the Antiquary, who made his well-known Itinerary in the reign of Henry VIII., mentions the Juniper as covering Towbury Hill Camp, near Ripple, in the Severn Valley, but not a stray individual bush now remains there.*"

The passage referred to is, I presume, the following, which I quote from Hearne's 2nd Edition, Vol. VI., p. 71, Folio 80 :—

"Tetbyri Castelle"

"Is a. 2 miles from Theokesbyri, above it, in ripa læva Sabrinæ, apon a Cliv with double diches, in the Paroche of Twyning. It is now overgrown with trees and bushes of Juniper."

The record is interesting, the Juniper being now very rare in Worcestershire; but the interest is diminished by the fact that the locality referred to by Leland is in the County of Gloucester.

* See Lowndes "Bibliographers' Manual," Vol. II., p. 1,022; Vol. III., p. 1,338.

From the date of Wm. Turner's Libellus, the earliest English work on Botany, to the middle of the 17th century, the more important works relating to English Botany are the following :—

William Turner.

" Libellus de Re Herbaria novus." 1538.
" Herbal," 1548.
" New Herball." 1551 to 1568.

Lobelius, (Matthias de l'Obel).

" Stirpium adversaria."
" Plantarum seu stirpium historia."
" Icones."
Various dates. 1570 to 1605. Partly published in London, partly at Antwerp.

John Gerard.

" The Herball." 1597.
2nd Edition, by Thomas Johnson. 1633.

John Parkinson, Apothecary, London.

" Paradisus terrestris." 1629.
" Theatrum Botanicum." 1640.

I have not examined any of these works, but conclude from the manuscripts of the late Mr. Newbould that they contain no Worcester records.

These appear for the first time in the "*Phytologia Britannica*," 1660, the first British Flora. The full title of this book is "Phytologia Britannica Natales exhibens Indigenarum stirpium sponte emergentium." [Londini. Typis Ric Cotes. 1650.] The name of the author is not given, but it is known to have been written by William How, M.D. It contains many local records, and among them two relating to the County of Worcester. These are—

"**Chedidonium minus flore pleno nondum descriptum.** Pilewort with a large flower. In Worcestershire."

(*Ranunculus Ficaria L.*)

"**Consolida regalis Tab. Delphinium Gesn. Flos regius Dod. Larkesheele.** In a Cornfield by Pershire in Worcestershire and thereabout frequently."

(*Delphinium Ajacis, L.*)

The second record is a very interesting one. The Larkspur is quite extinct in Worcestershire, and has not been seen within the county by any living Botanist.

The next work to be mentioned is *Merrett's Pinax*, 1666. Its full title is "Pinax rerum naturalium Britannicarum

Authore Christophoro Merrett." [Londini. Cave Pulleyn. 1666.] It contains 8 Worcester records. Two are a cultivated Wheat and Barley; a third is the Larkspur, simply quoted from the Phytologia. The remaining five are—

"**Bellis flore herbaceo globoso.** In Mr. Selden's Cops neer his house in Worcestershire. Mr. Morgan."

(*Bellis perennis, L., probably a form without rays.*)

"**Gentiana autumnalis flore albo, foliis longis angustis.** In old Pastures on the north west of Church Lench, Wostershire, plentifully."

(*Gentiana Amarella, L.*)

"**Lactuca sylv. laciniata minima.** N. D. near Church Lench in Wostershire in great plenty."

(*Probably Lactuca saligna, L.*)

"**Rosa sylv. odore flore duplici, Double Eglantine, G. 1270,** invenitur duplici & triplici serie petalorum, in sepibus præsertim prope Wigorniam. Mr. Brown."

(*Double Sweet Briar, Rosa rubiginosa, L., perhaps cultivated.*)

"**Rosa pimpinellæ fol. fl. rubro.** In some barren fields near Worster. Mr. Brown, and in a barren field at Church-lench four miles beyond Evesham in great plenty."

(*Probably Rosa spinosissima, L.*)

The next step in the history introduces us to John Ray. This remarkable man was born at Black Notley, near Braintree, in Essex, in 1628, and died at the same place in 1705. He was educated at Braintree School, and at St. Catharine's and Trinity, Cambridge, of which latter College he became a Fellow, Lecturer and Dean. In 1660 he was ordained Deacon and Priest. In 1662 he was deprived of his Fellowship on his refusing to sign the declaration required by the Act of Uniformity. In 1667 he was made a Fellow of the Royal Society. Among his pupils at Trinity was Francis Willoughby, of Middleton Hall, Warwickshire, between Sutton Coldfield and Tamworth, whose second son was raised to the Peerage, by Queen Anne, under the title of Lord Middleton. Ray lived upon terms of close friendship with Francis Willoughby, was a frequent visitor at Middleton, and on Willoughby's death in 1672, was appointed one of his Executors and Tutor to his sons. From 1675, or 1676, to Michaelmas, 1677 Ray lived at Sutton Coldfield and then removed into Essex, where he continued to his death.*

Of Ray's numerous works in various departments of Natural History we need only concern ourselves with two, the

* "Memorials of John Ray." Ray Society, 1846.

"*Catalogus Plantarum Angliæ*," first edition 1670, second edition 1677; and the "*Synopsis Methodica Stirpium Britannicarum*," first edition 1690, second edition, 1696. Of the last named work, a third edition was published after Ray's death in 1724, under the Editorship of Dr. J. J. Dillenius, at that time Professor of Botany in the University of Oxford.

The "*Catalogus Plantarum Angliæ*, 1670, contains only one Worcester record, but it is one of special interest. At p. 90 we read—

"**Cynoglossa folio virenti**, J. B.
Cynoglossum minus folio virente, Ger.
Cynoglossum semper virens, G. B. Park.
The lesser Hounds-tongue.
. . . also in some shady lanes near Worcester"

The record occurs in the same words in the edition of 1677.

We must now leave Ray for a time, in order to make acquaintance with the earliest Worcester Botanist, in the person of Mr. Edmund Pitt, of that city, Apothecary and Alderman.

In the "*Philosophical Transactions*" for April, May, and June, 1678, No. 139, p. 978, we read as follows:—

"Extract of a letter from Mr. Edmund Pitt, Alderman of Worcester, a very knowing Botanist, concerning the Sorbus Pyriformis.

Last year I found a rarity growing wild in a forest of Worcester. It is described by L'Obelius under the name of Sorbus Pyriformis, also by Mathiolus upon Dioscorides, And by Bauhinus, under the name of Sorbus Procera. And they agree that in France, Germany and Italy, they are commonly found. But neither These nor any of our own countrymen as Gerard, Parkinson, Johnson, How, nor those Learned Authors Merret or Ray, have taken notice of its being a native of England. Nor have any of our English Writers so much as mentioned it. Saving that Mr. Lyte, in his translation of Dodonæus, describes it under the name of the Sorb Apple. But saith no more of the place, but that it groweth in Dutch-Land.

It resembles the Ornus or Quicken-Tree; only the Ornus bears the Flowers and Fruit at the end, This on the sides of the Branch. Next the sun the Fruit hath a dark red blush: and is about the bigness of a small Juneting Pear. In September so rough as to be ready to strangle one. But being then gathered and kept till October, they eat as well as any Medlar. Thus far the Letter.

Q. Whether a Verjuyce made of this Fruit, either ground with Crabs or Grapes, or if plentiful alone, would not, being kept for some time, prove one of the best acid-astringent Sawces that Nature affords."

This is the first notice of the celebrated Wyre Forest Sorb Tree, which, after having attracted the visits of many generations of Botanists, was destroyed by fire by some miscreant in 1862. A view of the tree, with a figure of the foliage and fruit, will be found in the plate opposite p. 10 of Nash's Worcestershire, (Vol. I., 1781,) and a full description in p. 11. A sketch of the tree in its last stage of decay is given by Mr. Lees, at p. 91 of the "Botany of Worcestershire." We have seen that Ray was elected a Fellow of the Royal Society in 1667. It is probable that Mr Pitt's letter was addressed to Ray, and contributed by him to the Philosophical Transactions.

The first edition of the Synopsis, 1690, gives very little further information relating to the County. At p. 75, we find a description of the Lesser green leaved Hounds-tongue, and the remark, "It hath also been observed in some shady lanes about Worcester, by Mr. Pitts." At p. 219, is a description of the Sorbus, with the note, that it is "said to grow wild in many places of the Morelands in Staffordshire, by Dr. Plot. Hist. Nat., Stafford, p. 208."

In 1695, Edward Gibson, of Queen's College, Oxford, subsequently Rector of Lambeth, Archdeacon of Surrey, Bishop of Lincoln, and finally Bishop of London, published his translation of Camden's Britannia. This book is of great interest to Botanists. At the end of the description of each County is a list of the rarer plants, contributed by Ray himself, the whole forming the first collection of County records published in this country. We learn from the preface that,

"The Catalogues of Plants at the end of each County were communicated by the great Botanist of our age, Mr. Ray. They are the effect of many years observation: and as that excellent Person was willing to take this opportunity of handing them to the publick, so were the Undertakers very ready to close with such a considerable Improvement tho' it exceedingly enhanced the expences of Printing, and they were no way ty'ed to it by their Proposals." The Worcestershire list is on page 528. It is a very meagre one and is worth quoting in full:—

"More rare plants growing wild in Worcestershire—

Colchicum vulgare seu Anglicum purpureum and album, Ger. Park. Common Meadow Saffron. I observed it growing most plentifully in the meadows of this County.

Cynoglossum folio virenti, J. B. Cynoglossum minus folio virente, Ger. Semper virens, C. B. Park. The lesser green leaved Hounds-tongue. It hath been observed in some shady lanes near Worcester by Mr. Pitts, an Apothecary and Alderman of that City.

Sorbus pyriformis, D. Pitts; which I suspect to be no other than the **Sorbus sativa, C. B. legitima, Park.** That is the true or manured Service or Sorb-tree. Found by the said Mr. Pitts in a forest of this County.

Triticum majus glumæ foliaceæ seu Triticum Polonicum, D. Bobert. An Triticum speciosum grano oblongo, J. B.? Polonian Wheat. It is found in the fields in this County, and as Dr. Plot tells us, in Staffordshire also."

These are the plants now known as *Colchicum autumnale, L.*, *Cynoglossum montanum, Lam.*, *Pyrus domestica, Sm.*, *Triticum Polonicum, L.* The latter is a cultivated wheat, and need not further engage our attention.

In 1722, Bishop Gibson published a second edition of his version of Camden but, in this, Ray's lists are simply reprinted verbatim.

The second edition of the Synopsis, published in 1696, contains no additional records ; nor yet does the 3rd edition, published in 1724, 19 years after Ray's death. We read, however, in the latter, under the head of the Meadow Saffron, "*In the Parish of Mathon in the Meadows under the Malverne Hills in Worcestershire plentifully, Mr. Manningham.*"

It is remarkable that Ray should have passed over without notice the records of How and Merret, and annoying that he should leave us in doubt whether the Worcester Apothecary and Alderman spelt his name with or without the s.

The Botanical works of the first half of the eighteenth Century yield, so far as I can ascertain, a single addition only to the Worcester Census, but it is one of great interest. In the *Hortus Elthamensis* of Dillenius, 1732, is a plate (Tab. lviii.) of Campanula patula, with the record (fol. 69),

> "Sponte nascentem reperi inter dumeta collis cujusdam sylvosi prope Worcestriam, (in a wood called Elbury Hill, about a mile from Worcester)."

The discovery is referred to by Richard Pulteney, in his "*Account of some of the more rare English Plants observed in Leicestershire*," in the Phil. Trans. for the year 1756-57, see Vol. XLIX, Part II., p. 815 ; and again in his Catalogue of Leicestershire plants, contained in the first volume of the "*History and Antiquities of the County of Leicester*," by John Nichols, 1795. In the latter work, at p. clxxix, we read, under Campanula patula,

> "First discovered in England, by Mr. Brewer, in 1726, near Worcester, as recorded by Dr. Dillenius."

The history of this period is fitly concluded by the "*Specimen Botanicum*" of John Blackstone. Its complete title is "Specimen Botanicum Quo Plantarum Plurium Rariorum Angliæ Indigenarum Loci Natales Illustrantur, Authore J. Blackstone, Pharm., Lond." [Londini, 1746.] It is rich in local records, mostly belonging to the Metropolitan Counties, the neighbourhoods of Oxford and Cambridge, and the County of York. It does not contain a single Worcester reference.

The records of the first period may be summed up as under :—

				Species.
How,	*Phytologia*,	1650	...	2
Merrett,	*Pinax*,	1666	...	5
Ray,	*Catalogus*,	1670	...	1
Pitt,	*Phil. Trans.*	1678	...	1
Ray,	*Gibson's Camden*,	1695	...	1
Dillenius,	*Hort. Eltham.*,	1732	...	1
				11

We have now reached the end of what may be termed the pre-Linnæan era. The adoption of the Linnæan system of classification, and the introduction of the binomial nomenclature, due to the publication, in 1753, of the first edition of the "*Species Plantarum*," made an epoch in Botanical Science.

(To be continued.)

THE DATA OF ETHICS.

BY CONSTANCE C. W. NADEN.

(Continued from page 63.)

Evolution has been possible only by the correlation of pains with injuries, and of pleasures with benefits. For if an organism persistently preferred what was hurtful to it, and disliked what was beneficial, that organism would have a very small chance of surviving, and transmitting to offspring its suicidal peculiarity. You cannot, for instance, transmit liking for starvation as a family trait. To a certain extent, then, the simple sensations are true and safe guides. But the evolutional progress is towards increased length and breadth of life; and with every fresh adjustment to the environment, involving new developments both of structure and function, the mental and bodily activities grow more coherent, more definite, and more heterogeneous. That is, acts are no longer isolated, but are connected into series; they are more delicately adjusted to ends; and they are more varied in kind. In order to preserve this continuity, fitness, and variety, the simple and presentative feelings must be restrained by complex and representative feelings; foresight must be exercised, and many immediate pleasures renounced for a greater but more remote good. The savage will hurt or maim himself to avert the anger of his fetish; he will risk his life in battle in obedience to the command of his chief, or to win a reputation for courage.

And here, indeed, we are "tracing the genesis of the moral consciousness," the main feature of which is self-control. This self-control is evolved within and by the religious, political, and social controls; but it differs from them in referring to the *intrinsic*, while they refer to the *extrinsic* effects of actions. The three external controls co-operate primarily for securing success in war, and secondarily for restraining aggressions within the community; they seek to preserve the society from foes without and from foes within. But the savage obeys his chief's command, or sacrifices to his fetish, or to his primitive "Mrs. Grundy," not so much from any perception that the natural consequences of non-conformity will be disastrous, as from a fear of its incidental consequences. He refrains from hurting his neighbour, not because he is unwilling that his neighbour should be hurt, but because he does not want to be punished. In time, however, the united influence of the political, religious, and social controls engenders a type of character which does spontaneously what was at first done under compulsion. From accumulated racial experiences of utility, moral intuitions are developed, and the pain which was of old connected simply with the punishment now becomes connected with the action to be punished. From the principles of evolution, it is as clear that this *must* happen as that individual pleasures must be correlated with individual benefits, and *vice versa*; for if the being best fitted to the physical environment is the most likely to survive and to leave offspring which may inherit its endowments, not less is this true of the being best fitted to the social environment. There are laws which impose penalties on me if I rob, or maim, or kill. If I have a nature sufficiently sympathetic to make me shrink from the intrinsic as well as the extrinsic effects of robbing, maiming, or killing—not only from the pain I may probably suffer, but also from the pain I shall certainly cause—then I am less likely to subject myself to punishment, and, so far, more likely to live and prosper.

Duty is an abstract sentiment, deriving its authority from a sense of the usually superior guidance given by re-representative feelings, and its compulsiveness from racial experience of the three lower controls, aided by a recognition of natural penalties.

It is, then, already clear that to a certain extent, evolution tends to the growth of unselfish motives, and that, broadly speaking, "true self-love and social are the same." No society can exist unless internal aggressions be restrained; unless, further, there be co-operation among its members, involving approximate equity, and performance of contract; and it is difficult to imagine the existence of any society without some degree of beneficence or spontaneous effort on the part of some of its members to promote the welfare of others. All this may happen without any thought being expended on *universal* welfare, or "the greatest happiness of the greatest number," which must always remain an Ideal rather than a definite object of endeavour. Half-blindly, slowly, with no set purpose, mankind has already worked out the main conditions of happiness, and embodied them in its moral code—Be strong, be just, be kind. Rational utilitarianism takes these results; and aims, not straight at happiness, but at the essential conditions of happiness. It endeavours to conform "to certain principles which, in the nature of things, causally determine welfare," and which are generalisations from past racial experience, rectified by present intelligence. The law of justice, for example, is a statement of the most fundamental conditions of happiness. Equity must always be maintained, whatever may be the immediate consequences; because the permission of a seemingly beneficial injustice makes the foundations of happiness insecure, while seeming to adorn the superstructure. The evolutional moralist must therefore insist on conformity to principle as strongly and as sternly as any believer in the Categorical Imperative.

But still, we have not reached a complete reconciliation of the claims of egoism and altruism. It is very evident "that a creature must live before it can act," and that "unless each duly cares for himself, his care for all others is ended by death; and if each thus dies, there remain no others to care for."* Survival of the fittest has been the law of evolution, and works for general, as well as for individual happiness, by ensuring the survival of the healthiest, and therefore of the happiest. It is our duty to be both healthy and happy; for our fitness or unfitness will be transmitted to

* Ch. XI., § 68.

future generations; and besides, excessive unselfishness not only fosters selfishness directly, by accustoming others to receive and expect undue sacrifices, but it also fosters selfishness indirectly, by tending towards the non-survival of the unselfish. A certain degree of egoism, then, is not only justifiable, but actually imperative. Try to imagine a state of things in which everyone cared for everyone else, and no one cared for himself; in which everyone, neglecting his own dinner, ran about with tit-bits for his neighbours, while they in turn besieged him with their own tit-bits. Clearly if all were purely altruistic, givers would be balked by finding no recipients; or else unwilling recipients must *pretend* to be pleased, in order to afford pleasure to the givers. Again, sympathy is only a representative feeling, and can never be quite so vivid as the original feeling which it represents; so that if egoistic pleasures and pain should fail, their sympathetic reflections must fade away and vanish. The image in the mirror will not remain when the imaged body is withdrawn. Then, although we may strip ourselves of happiness for the sake of others, we cannot give them all that we renounce. Bodily health, the joys of success, and all intimate and individual feelings, are as non-transferable as a railway ticket.

And yet altruism has been as necessary as egoism to the preservation of the race. Consider its earliest manifestation—parental love and care—which "in its simple physical form" is "absolutely necessary for the continuance of life from the beginning," and which developes in complexity and duration with the development of higher organic types. This parental care has become an instinct—an insistent, imperative instinct—often overpowering the strongest egoistic cravings. Where there is family altruism, social altruism has a chance of evolving; and we have seen that men living in society are obliged to be to some extent altruistic. Their individual welfare depends largely on the welfare of the community. To be just, to see justice done to others, to maintain and improve the agencies which administer justice; this is the true policy of every citizen. But to crown his joy, he must be spontaneously kind and beneficent, as well as just, for thus only can he know the pleasures of friendship and sympathy; thus only can he renew his youth when he is old, his strength when he is infirm, and feel all his lost delights by proxy.

But if egoism is essential, and altruism also essential, and yet the two conflict; what is our hope? Will the weary battle go on for ever? Is there no prospect of a final peace?

There is such a prospect. We have already seen that evolution works towards perfect adaptation to the environment. Pleasures and pains are not fixed and absolute; they are relative to structures and to the states of structures; and as organisms adjust themselves physically to the conditions of their life, they must at the same time adjust themselves psychically. That is, every mode of action demanded by social conditions must eventually become pleasurable to social beings, and as parental love is already an instinct, so the broader love, not only of country, but of the race, will in time become instinctive. Sympathy, hitherto stunted by adverse conditions, will develop; and as human nature improves, the natural language of feeling will be less restrained; looks, words, tones will all grow more expressive, and the power of interpreting them will strengthen and sharpen by use. As the sphere of sympathetic gratification widens, the sphere of self-sacrifice will diminish; for with growing efficiency and increasing welfare there will be fewer troubles to assuage, fewer pangs to partake. No one will be willing to accept benefits at the cost of pain or privation to others. It would be curious to speculate on what might happen if the balance began to descend on the altruistic side, and love for one's neighbour grew actually more potent than love for one's self. Then the moral dangers and hence the moral judgments of mankind would be reversed. The egoist would then possess a rare but desirable virtue, and so be counted a saint; self-seeking and self-assertion might be reckoned as attributes of holiness, and even the thief might be looked upon leniently, as endowed with an overplus of the unusual quality of acquisitiveness. The heaviest censure would be reserved for vicious excesses of generosity, humility, long-suffering, renunciation, charity.

But leaving this quaint possibility, there is certainly something inspiring in the contemplation of a future merging of generosity in equity; of a perfectly pleasurable altruism; of a state in which all actions should be "absolutely right." To-day, most actions are only relatively right; that is, are partially wrong; for most are attended with some degree of pain, either to self or to neighbours. An absolutely right action is one which produces pure, unadulterated pleasure; but this can happen only when evolution has perfectly adjusted desires to conditions. And at present, such perfect adjustments are possible only or chiefly in the lower part of our nature, which has been moulded to its environment before social evolution began. A healthy mother suckling her infant, a father playing with his boy, are not performing duties of a very high order; but what they are doing is in itself absolutely right, being a source of mutual pleasure. In time, the higher part of our nature will be similarly perfected; and a foreshadowing of this ultimate development may even now be seen in the almost or entirely unmixed pleasure afforded by certain æsthetic and benevolent activities. It is this conception of the completely adapted man in the completely evolved society with which moral science must deal, just as physics and astronomy must assume in the first place certain ideal conditions, making allowance subsequently for actual incidental conditions. The rigid and weightless lever is a fiction; the ideal man is a fiction; but both are fictions which have a direct and practical bearing on reality. Only, while the physicist's lever can never become a reality, the moralist's man may yet tread the earth in flesh and blood; ethically adult, having outgrown that sense of self-control and self-compulsion, which is so often painful to the best of us; no more conscious of the demands of duty than he is conscious of the beatings of his own heart. Here philosophy and poetry meet and clasp hands; for the picture drawn by Mr. Spencer cannot be distinguished from that drawn by Wordsworth in his "Ode to Duty."

> "Serene will be our days and bright,
> And happy will our nature be
> When Love is an unerring light,
> And joy its own security.
> And they a blissful course may hold,
> Even now, who not unwisely bold,
> Live in the spirit of this creed,
> Yet find that other strength, according to their need."

THE MIDDLE LIAS OF NORTHAMPTONSHIRE.

BY BEEBY THOMPSON, F.G.S., F.C.S.

General Failure of Deep Springs.

(Continued from page 58.)

The general failure of the water supply from deep-seated springs is becoming a most serious matter in England, and one which requires dealing with in a comprehensive manner. The falling off is probably most serious in the North of England, where large towns are common, and great quantities of water are required for manufacturing purposes; but it is not confined to these parts. Many Midland and Southern towns have felt the inconvenience of a short allowance, and paragraphs recording the falling-off of water supply are frequent in the newspapers. The history of the struggles, and successes, and failures in various parts may be read in numerous Reports, and there is a great similarity in them ; spite of the deepening of wells, increase of pumping power, going to greater distances, etc., the available water is getting less.

At Northampton the same kind of thing has been taking place. In 1836 a shaft was sunk near to Kingsthorpe, at a point about 2½ miles N.E. of Northampton, with the object of finding coal, and according to the account left of this sinking, when the Middle Lias was pierced, at a depth of 210 feet,* a large quantity of water was met with, which was estimated at 36,000 gallons per hour—that is, about 864,000 gallons per day. No use was made of the water, but the finding of it induced the Water Company of Northampton to sink a well into the Middle Lias about ten years afterwards. This well was made on a piece of ground near to the Billing Road, at a point about two miles South of the Kingsthorpe one ; it was sunk to a depth of 150 feet, and then a bore hole, 21 inches in diameter, was made some 18 feet deeper. About 500,000 gallons a day was obtained, and the water rose to within 60 feet of the surface. This supply was made available in 1848. It very soon became evident that the water level was sinking ; however, as there was an increased demand for water, a second well was sunk within 40 feet of the first in 1866, and with the aid of larger pipes and more powerful pumps, a yield of 860,000 gallons per day was obtained. This increased yield of course produced a more rapid fall in the water level, and in 1874 the amount of water that could be pumped had considerably diminished, and its head level in the well been reduced from 90 feet to 20 feet. About this time the well was deepened by divers, but the supply of water obtainable, and the level of that water, has been diminishing ever since, though the latter at a less rapid rate than the former. The water now (1884) does not rise above the Rock-bed, the top bed of the Middle Lias, I believe, and the quantity is totally inadequate to the supply of the town.

The reasons for this decline in water level and consequent yield of water are tolerably evident, for other wells in this district, and wells in different geological formations in other districts, have the same tale to tell :—(1) More water is being pumped from the pervious beds annually than would ever get in naturally in the like period. (2) Less water gets into these

* There are reasons for doubting the accuracy of this depth. The matter will be referred to later on.

beds now than formerly owing to excessive, and in some cases indiscriminate agricultural drainage. No doubt both of these causes have been in operation in Northamptonshire, but the former has had much more effect than the latter.

I tried to form an estimate of the amount of water that might reasonably be expected to get into the Middle Lias of the county annually, supposing no artificial impediments were interposed, and so to see what relation it bore to the amount actually extracted from the Marlstone wells at Northampton. Almost at the outset it became evident that any such estimate founded upon catchment area would be of little or no value, but the attempt considerably modified my ideas of the extent of catchment area in the direction of reducing it. On looking at a geological map of the district, it will be noticed that nowhere does the Middle Lias cover a very extensive uninterrupted surface area, owing to numerous Upper Lias hills rising above it, or to valleys cut through it, a natural consequence of its comparatively small thickness. Besides this, even where coloured as Marlstone in the maps, it is not unfrequently covered by the lowest beds of the *Upper Lias*,* and these by interposing one or more thin clay beds between the surface and the Rock-bed would materially reduce the intake of water, as would also the capping of *boulder clay* that is sometimes found similarly situated. The Middle Lias is still more often covered with *drift* in the form of thick beds of sand or gravel; indeed, so completely is the Middle Lias catchment area covered to the North-west of Northampton that the boundaries of its outcrop are only approximately indicated on the maps by dotted lines. This drift can scarcely be regarded as injurious, and may be very helpful, by, as it were, extending the catchment area of the Middle Lias.

The effect of streams in reducing the water-bearing capacity of the Middle Lias of Northamptonshire is no doubt greater than that of all of the other causes named, for not only do they destroy the continuity of the bed by cutting it up into outliers and peninsula-like masses of no great storage capacity, but they very considerably drain these and the escarpments of the main bed. Also the main mass of Middle Lias to the South-west of Northampton is well drained by streams.

The Nen, Cherwell, Leam, and Avon each receive considerable contributions from the Middle Lias.

* I have so frequently found fossils from the stone beds at the base of the Upper Lias in Northamptonshire, marked as Marlstone, that I think they must at one time have been regarded as Middle Lias.

In considering the area which can contribute to the water supply of Northampton itself, it will be necessary to pay much attention to the great Nen "fault," but that may be fairly left for the present.

I must say that I do not think Agricultural Drainage has had much to do with the scarcity of water from the Marlstone, because the Marlstone area is well drained naturally, but that the diminution is chiefly owing to the quantity pumped annually being in excess of the annual impounded rainfall which is naturally available. When the Northampton Water Company noticed how rapidly the water level was sinking in their Billing Road well, they might have been sure of the fact that they were draining a reservoir of water more rapidly than it could be filled, and that consequently there was a limit to the time it would last. They adopted the plan pursued in so many other places, of making fresh wells and new headings, and so increasing the present supply with the fact before them that they were only the more rapidly exhausting the bed. The result was exceedingly manifest in the shortness of water, the supply being limited for a long time to three hours a day.

Agricultural Drainage, by carrying away rapidly very much of the water which formerly found its way into the rocks below, has no doubt reduced the water-bearing capabilities of many beds, and at the same time helped to cause floods in the river valleys. As I said before, I do not think the diminution in the Marlstone supply is great on this account, but nevertheless it is a factor which must not be lost sight of, and there is little doubt that the excessive floods in the valleys of Northamptonshire are due in part to the excessive drainage of other strata forming the uplands. I have spoken of the drainage as excessive chiefly because the continuance of wet seasons has caused some people to drain as though wet seasons were always to be. These lands may correspondingly suffer if we have a succession of dry and hot seasons.

(To be continued.)

MIMICRY IN INSECTS.

The beetles and flies of Central America must have learned by experience to get out of the way of the nimble Central American lizards with great agility, cunning, and alertness. But green lizards are less easy to notice beforehand than brown or red ones ; and so the lizards of tropical countries are almost always bright green, with complementary shades of yellow, grey, and purple, just to fit them in with the foliage they lurk among. Everybody who has ever hunted the green tree-toads on the leaves of waterside plants on the Riviera must know how difficult it is to discriminate these brilliant leaf-coloured creatures from the almost identical background on which they rest. Now, just in proportion as the beetles and flies grow still more cautious, even the green lizards themselves fail to pick up a satisfactory livelihood ; and so at last we get that most remarkable Nicaraguan form, decked all round with leaf-like expansions, and looking so like the foliage on which it rests that no beetle on earth can possibly detect it. The more cunning you get your detectives, the more cunning do the thieves become to outwit them. Look, again, at the curious life-history of the flies which dwell as unbidden guests or social parasites in the nests and hives of wild honey-bees. These burglarious flies are belted and bearded in the very selfsame pattern as the bumble-bees themselves ; but their larvæ live upon the young grubs of the hive, and repay the unconscious hospitality of the busy workers by devouring the future hope of their unwilling hosts. Obviously, any fly which entered a bee-hive could only escape detection and extermination at the hands (or stings) of its outraged inhabitants, provided it so far resembled the real householders as to be mistaken at a first glance by the invaded community for one of its own numerous members. Thus any fly which showed the slightest superficial resemblance to a bee might at first be enabled to rob honey for a time with comparative impunity, and to lay its eggs among the cells of the helpless larvæ. But when once the vile attempt was fairly discovered, the burglars could only escape fatal detection from generation to generation just in proportion as they more and more closely approximated to the shape and colour of the bees themselves. For, as Mr. Belt has well pointed out, while the mimicking species would become naturally more numerous from age to age, the senses of the mimicked species would grow sharper and sharper by constant practice in detecting and punishing the unwelcome intruders. It is only in external matters, however, that the appearance of such mimetic species can ever be altered. Their underlying points of structure and formative detail always show to the very end (if only one happens to observe them) their proper place in a scientific classification. For instance, these same parasitic flies which so closely resemble bees in their shape and colour have only one pair of wings apiece, like all the rest of the fly order, while the bees, of course, have the full complement two pairs, an upper and an under, possessed by them in common with all other well-conducted members of the hymenopterous family. So, too, there is a certain curious American insect, belonging to the very unsavoury tribe which supplies London lodging-houses with one of their most familiar entomological specimens ; and this cleverly disguised little creature is banded and striped in every part exactly like a local hornet, for whom it evidently wishes itself to be mistaken. If you were travelling in the wilder parts of Colorado you would find a close resemblance to Buffalo Bill was no mean personal protection. Hornets, in fact, are insects to which birds and other insectivorous animals prefer to give a very wide berth, and the reason why they should be imitated by a defenceless beetle must be obvious to the intelligent student.—*From the "Cornhill Magazine" for February.*

Review.

Catalogue of Canadian Plants. Parts I., II., and III. ; *Polypetalæ, Gamopetalæ,* and *Apetalæ.* By John Macoun, M.A., F.L.S., F.R.S.C. Dawson Bro., Montreal. Royal 8vo., pp. 623.

This important work, which is one of the publications of the Geological Survey of Canada, reflects the greatest credit upon the author, and no commendation can be more than sufficient for the admirable way in which the work has been compiled. Although the modest title of "Catalogue" is affixed to this work it is in fact a Flora, and a very valuable Flora, of that vast region, the Dominion of Canada, including also Newfoundland ; and in the present Volume I. we have a full record, so far as this is known, of the botany of Canada from Ranunculaceæ to the end of the Exogens. The second volume, which is in a fairly complete form, will also consist of three parts. Part I. will contain all the Endogens ; Part II., the Anophytes and Acrogens ; Part III., the Thallogens.

The purpose of this work is to place in the hands of Canadian botanists, in a connected form, a full record of all that is known of the number and distribution of Canadian plants. That much and valuable work has been done is evidenced by the fact that although the present volume includes the Exogens only, 2,207 species belonging to 584 genera have been recorded, and their distribution traced more or less fully from Newfoundland to Vancouver Island.

In compiling this volume Professor Macoun has availed himself of all published records, such as Sir William Jackson Hooker's great work, the "Flora Boreali-Americana," which contained the records of the work of the early travellers and explorers ; and also the splendid "Flora of North America," by Torrey and Gray, the first volume of which appeared in 1840, and the last published volume, which completes the Gamopetalæ, in 1878. In addition to these is the long experience of more than a quarter of a century of Professor Macoun, whose observations in the field extend from the eastern provinces to the Pacific, and whose industrious research includes not only his own personal observations, but also a careful examination of the various herbaria existing in the Dominion. and of the proceedings, reports, and lists that have from time to time emanated from the various natural history and scientific societies of the Dominion. The work which this volume records commenced considerably prior to the opening up of the country by modern enterprise, at a time when what are now flourishing communities were vast forests, prairie lands, and swamps, so that a true idea could be formed of the primitive flora; the gradual spread of alien weeds, the results of cultivation, reclamations, and the like could be watched and their presence accounted for. Hence this work will not only be a good foundation for a fuller and more perfect Flora of Canada, but a work of standard value for all future botanists. Comparing this "Catalogue" with Asa Gray's excellent "Manual of the Botany of the Northern United States," it will be found, as might be expected, that a great affinity exists between the Flora of the United States and that of the Dominion. What, however, appears to the writer most interesting is the great number of British plants to be found as either native, alien, or introduced plants in this region, some of them being wide spread and evidently of very ancient origin there. Out of the 2,201 species recorded, about 400 are found also in Britain. Of these about 235 are indigenous to Canada, and 161 aliens, being either introductions, casuals, or escapes. Many of these alien plants have established themselves, and are in some cases somewhat unwelcome visitors. A few instances may be given. *Ranunculus acris*. L., which is stated to be a pernicious weed in the eastern provinces and western part of Ontario. *Brassica Sinapistrum* Boiss., a vile weed in cultivated fields and waste grounds, from New Brunswick, throughout Quebec and Ontario. *Capsella Bursa-Pastoris*, Mœnch, found in profusion, wherever there is cultivation, from the Atlantic to the Pacific. *Raphanus raphanistrum*, Linn.; a troublesome weed in many parts. *Lychnis githago*, Lam.; wherever wheat is cultivated this weed is found abundant. *Stellaria media*, With; introduced into all garden ground from the Atlantic to the Pacific. *Spergula arvensis*, L.; troublesome in damp fields. *Chrysanthemum leucanthemum*, L.; an obnoxious weed in many sections of the eastern provinces and Ontario. *Polygonum aviculare*, L.; wherever the smallest settlement is made this weed is sure to appear. *Chenopodium album*, L., is rapidly taking possession of railway banks, ditches, and other places, and is used as a pot herb in many places. It is known in Canada by the common name of Lamb's quarters. Many others might be mentioned did space permit.

Of the British species also indigenous to Canada only a few of the more rare can be noticed. *Myosurus minimus*, L., which with us is a local cornfield plant, is found there in rocky pastures and arid spots occasionally, from Ontario to Vancouver Island. *Arabis petræa*, Lam.; an alpine plant in Wales and North Britain, is found throughout Canada, extending westward to the Rocky Mountains. *Cochlearia anglica* and *C. danica*, L., are plants of the arctic shores. *Silene acaulis*, L., is found on elevated parts of the Rocky Mountains, and throughout arctic and sub-arctic America from Labrador to Behring's Straits. *Cerastium alpinum*, L.; arctic America, and adjacent islands, Rocky Mountains, etc. *Linum perenne*, L., is very common throughout the prairie regions. *Astragalus hypoglottis*, L., is abundant in the eastern prairie region and north to Peace River, and east of the Rocky Mountains. *A. alpinus*, L., has a wide range from Newfoundland and Labrador to the Rocky Mountains and northern British Columbia. *Dryas octopetala*, L.; Rocky Mountains, and over a wide range to Behring's Straits, the islands of the Arctic Sea and Greenland. The beautiful *Parnassia palustris*, L., occurs throughout Canada as far north as the arctic circle, and on swamps on the Rocky Mountains; frequent also in British Columbia. *Ludwigia palustris*, L., is very common in ditches and dried-up ponds throughout Ontario, and over a wide range in Canada. *Linnæa borealis*, L., a very rare northern plant in Britain, is very abundant in cool mossy woods from the Atlantic to the Pacific. *Vaccinium uliginosum*, *V. Myrtillus*, *V. Vitis-Idæa*, *V. Oxycoccos*, *Arctostaphylos alpina*, *A. Uva-Ursi*, and *Loiseleuria procumbens* are all abundant and widely spread, whilst the whole of the Ericas are absent, and our common *Calluna vulgaris* is confined to a very limited district on the east coast of Newfoundland. Space will not allow of a further notice of these plants, enough having been given to show that whilst this work will be invaluable to the Canadian botanist it has also many points of interest to British botanists, and is a valuable addition to our knowledge of geographical botany.

J. E. B.

METEOROLOGICAL NOTES.—February, 1887.

The mean of atmospheric pressure was above the average. The barometer rose, from the commencement of the month, to 30·767 inches on the 8th, its highest point, after which it fluctuated downwards till the 24th, and again rose rapidly. Temperature was slightly below the average. A few warm days were experienced at the beginning and end of the month. The highest readings were:—58·1° at Loughborough, on the 27th and 28th; 55·8° at Southwell, 55·6° at Hodsock Priory, 55·0° at Henley-in-Arden, and 54·3° at Coston Rectory, on the 27th; and 53·5° at Binley Vicarage (Coventry), on the 25th. In the rays of the sun, 103·8° at Hodsock, and 103·3° at Loughborough, on the 28th. The lowest minima were:—16·5° at Coston, on the 17th; 20·2° at Southwell, on the 8th; 20·6° at Hodsock, on the 9th; 21·0° at Henley, 21·8° at Binley, and 22·3° at Loughborough, on the 17th. On the grass, the thermometer recorded a minimum of 13·3° at Hodsock, on the 9th; 18·0° at Southwell, on the 8th; and 19·6° at Loughborough, on the 17th. The amount of rain-fall was decidedly below the average, though more than in February, 1885, and varied from 0·67 of an inch at Binley, to 0·52 of an inch at Southwell; the number of "rainy days" not exceeding 8. Sunshine was considerably in excess of the average for the month. A lunar halo was observed at Loughborough, on the 4th. The dry, frosty air was particularly favourable to agricultural operations.

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Wayside Notes.

The Entomologist's Monthly Magazine for March contains a note from a well-known local entomologist, Mr. W. G. Blatch. "On Christmas day last one of my sons found a small beetle walking on the outside of an orange in my house at Small Heath, Birmingham. Being in some uncertainty as to the species, I sent it to the Rev. A. Matthews, who pronounced it to be *Sacium pusillum*."

Owing to the Pressure on our space we are compelled to postpone the promised descriptions of Mr. Bolton's new rotifers, mentioned last month, until our next number.

The Mason College has lost one of its professors, and the Birmingham Natural History and Philosophical Societies an active working member, by the sudden removal of Dr. John B. Haycraft, the College Physiologist, to temporary duties as "professor-substitute" during the ill health of Dr. Rutherford, at Edinburgh, to be followed by a permanent appointment on the University staff. Abundance of good wishes for his future will go with him from his friends in the Midland Metropolis. We see that one of the Birmingham daily papers describes Professor Haycraft as having undertaken the duties of "Professor of Theology." Almost simultaneously with this delightful suggestion (worthy of Mark Twain's "English as she is taught"), we receive the card of a local supplier of gardener's materials in which, in praising the virtues of cocoa-nut fibre refuse, he ascribes to it "considerable antisceptic properties." We strongly urge upon Professor Haycraft the advisability of giving this substance a fair and free trial in his new avocation. We do not know whether one and the same Mrs. Malaprop was responsible for both of the above slips. In justice it ought to have been so, for there is a fine dual association of "antisceptic" and "theology" on the one hand, and "antiseptic" and "physiology" on the other.

In the Zoologist for January last some remarks were made, in an editorial, upon the "Horse-shoe Bats." Mr. J. E. Kelsall, in this month's issue, supplements this by some details as to the recorded distribution of the smaller species, *Rhinolophus hipposideros*, in Britain, from which we extract the following references to the Midland Counties:—Worcestershire. Dr. Hastings, in his "Illustrations of the Natural History of Worcestershire" (1834), includes (p. 62) "The large Horse-shoe," *R. ferro-equinum*, but not the lesser species.—Gloucestershire and Warwickshire were added by Mr. Tomes in the second edition of Bell's "British Quadrupeds" (1874), though it cannot be considered common in the latter county, since Mr. Tomes mentions only two localities for it—Welford and Ragley near Alcester. In the former county it is stated to be not rare at Cirencester.—Staffordshire. The lesser Horse-shoe Bat is not mentioned by Garner in his "Natural History of the County of Stafford," but Mr. J. R. Masefield, in a paper on "The existing Indigenous Mammalia of North Staffordshire," includes it as occurring near Burton, on the authority of Mr. Edwin Brown. It is remarkable that these counties appear to form the south-eastern limit of this Bat in England, for, although numerous other species have been met with, this one has never been recorded to the south-east of these counties. In Herefordshire it has been taken over the kitchens at Sufton Court, as recorded by Mr. R. M. Lingwood (Ann. and Mag. Nat. Hist., 1840, p. 185). From Derbyshire we have the evidence of Sir Oswald Mosley, in his "Natural History of Tutbury," that he received many specimens from "the calcareous caverns of Dovedale and Matlock," and believed it to be dispersed over the whole of the limestone districts of the county. In Nottinghamshire, Mr. Whitacre has not met with it, but Mr. J. Ray Hardy, of the Manchester Museum, informs me that he picked up a dead one from the ground at Edwinstowe, in Sherwood Forest, years ago, "too far gone to make a good specimen." In sending me two Irish specimens he observed that if these are rightly named (as they certainly are), the Nottinghamshire specimen was identical with them.

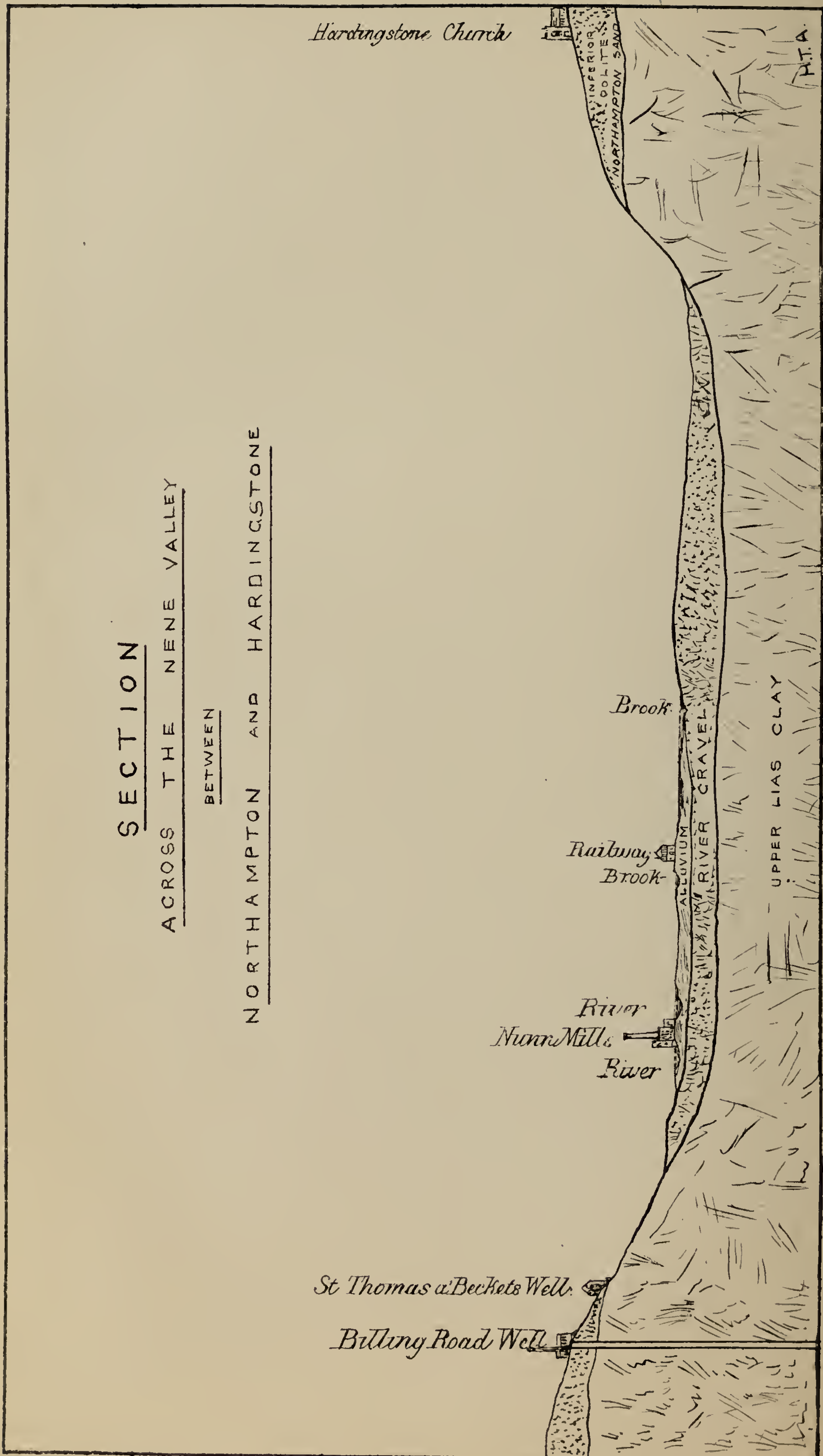
Caterpillars Incog.—The geometric moths have brown caterpillars, which generally stand erect when at rest on the branches of trees, and so resemble small twigs; and in order that the resemblance may be the more striking, they are often covered with tiny warts which look like buds or knots upon the surface. The larva of that familiar and much-dreaded insect, the death's-head hawk-moth, feeds as a rule on the foliage of the potato, and its very varied colouring, as Sir John Lubbock has pointed out, so beautifully harmonises with the brown of the earth, the yellow and green of the leaves, and the faint purplish blue of the lurid flowers, that it can only be distinguished when the eye happens accidentally to focus itself exactly upon the spot occupied by the unobtrusive caterpillar. Other larvæ which frequent pine trees have their bodies covered with tufts of green hairs that serve to imitate the peculiar pine foliage. One queer little caterpillar, which lives upon the hoary foliage of the sea-buckthorn, has a grey-green body, just like the buckthorn leaves, relieved by a very conspicuous red spot, which really represents in size and colour one of the berries that grow around it. Finally, the larva of the elephant hawk-moth, which grows to a very large size, has a pair of huge spots that seem like great eyes; and direct experiment establishes the fact that small birds mistake it for a young snake, and stand in terrible awe of it accordingly, though it is in reality a perfectly harmless insect, and also, as I am credibly informed (for I cannot speak upon the point from personal experience), a very tasty and well-flavoured insect, and "quite good to eat" too, says an eminent authority. One of these big snake-like caterpillars once frightened Mr. Bates himself on the banks of the Amazon.—*From "Strictly Incog." in the "Cornhill Magazine" for February.*

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—Geological Section, February 15th. Mr. T. H. Waller, B.A., B.Sc., chairman; thirty-five present. Mr. T. H. Waller was re-elected chairman, Mr. J. Udall was re-elected secretary of the section. The chairman announced the receipt of the "Proceedings of the Royal Physical Society, 1885-6," with a request that the Birmingham Natural History and Microscopical Society should make a regular exchange of its "Transactions" with the above society. A very interesting series of views in Switzerland (taken during a holiday ramble by Mr. C. J. Watson) was shown, with the aid of the oxyhydrogen lantern, by Mr. C. Pumphrey. Mr. C. J. Watson added much to the interest of the members by his description of each view, as it was projected on the screen. Professor Hillhouse, president of the society, promised a paper on the "Distribution of Plants in Geological Time," for the meeting on March 15th.—Microscopical Meeting, March 1st. Prof. W. Hillhouse, M.A., the president, occupied the chair. This being the first meeting of the section under the new arrangement, he gave an introductory address explaining the work of the section. Mr. W. H. Wilkinson was elected secretary of the section. Two specimens of the glass coral sponges of Japan, *Hyalonema*, were exhibited by Mr. H. G. Young. Mr. W. P. Marshall, M.I.C.E., then gave his paper on the "Measurement of the Magnifying Power of Microscope Objectives," and exhibited his new 1-25 inch water immersion objective. He illustrated the paper by diagrams, and showed a series of diatoms as test objects under microscopes, thus affording a good opportunity of appreciating the great advantages of his new lens. He also made sketches from it by the camera lucida. Remarks were made upon its use and structure by Prof. Hillhouse, Messrs. W. R. Hughes, F.L.S., T. H. Waller, B.Sc., and J. Levick. The exhibition was much appreciated by the large attendance of members and friends.—BIOLOGICAL SECTION, March 8th. Mr. R. W. Chase in the chair. A paper was given by the Rev. H. Friend, of Worksop, on Micro-Fungi, describing the minute parasitic growths that infest various plants, as mildew, mould and rust, &c., causing extensive damage in some cases from their great rapidity of growth. The paper was illustrated by a series of interesting coloured slides, prepared by Mr. Friend, and exhibited in the lantern by Mr. C. Pumphrey.—GEOLOGICAL SECTION, March 15th: sixteen present. Mr. T. H. Waller, B.A., B.Sc., in the chair. Mr. John Farthing, Prescott House, Kenilworth, elected a member. Specimens: Mr. Blakemore, *Sagartia bellis*, the daisy anemone, from Shanklin; Mr. Cullis, mica schist with garnets, basalt containing olivine inclusions, both from Scandinavia. Notice given that at the next General Meeting it will be proposed that the word Committee (in the Laws) be changed to Council. Professor Hillhouse read a paper on the "Distribution of Plants in time"; a cordial vote of thanks was given to the Professor. It was resolved that the Publishing Committee be requested to have the above paper printed in the "Midland Naturalist" at an early date.—BIOLOGICAL SECTION. Supplementary Meeting, Friday, March 25th. Mr. R. W. Chase in the chair. Professor Hillhouse gave the conclusion of his address on the "Life History of Mosses," tracing the gradual development from the fertilised archegonium to the matured ripe capsule discharging its spores.—SOCIOLOGICAL SECTION, March 22nd. Mr. W. R. Hughes, F.L.S., in the chair. A paper was read by Mr. F. J. Cullis, F.G.S., on the first four chapters of Mr. Herbert Spencer's "Data of Ethics," in which the gradual development of moral conduct was considered from the naturalist's point of view.—At supplementary meetings, on March 3rd and March 17th, Mr. W. R. Hughes, F.L.S., in the chair, papers on the first portion of Mr. Spencer's "Factors of Organic Evolution" were read by Mr. Alfred Browett. At these two meetings tea was served at 5.30.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—February 21st. Mr. P. T. Deakin exhibited specimens of *Helix pygmæa*, *Zonites radiatulus*, and other shells from Solihull; Mr. J. Madison, *Mya truncatula*, with siphon and other marine shells. Under the microscopes Mr. Hawkes showed archegonia and gemmiparous conceptacles of *Marchantia polymorpha*; Mr. J. W. Neville, a slide of a series of jaws of Helices, mounted for comparison.—February 28th. Mr. C. P. Neville exhibited a specimen of sea fan (Gorgonia). Mr. A. T. Evans then read a paper on the "Geology of the Birmingham District." The writer spoke of rocks as being of two kinds, Archæan, in which all traces of life were held to be obliterated, and Fossiliferous. The former were divided into two sections, Huronian and Laurentian, which were reviewed with some theories of their formation. They were devoid of fossils with possibly one exception. From this point the writer described the rocks of the district. The Cambrian and Silurian were well represented, but we had then a great gap that brought us to the coal period. One of the most singular features in this formation is the 30ft. seam of coal in the Bilston district, thinning out and being separated by sandstone layers into 330ft. at Pelsall. The Permian and Trias were dealt with at some length, and some of the missing secondary rocks remarked upon. The writer concluded by recommending patient and diligent work in the Lickey quartzite and drift-beds, as fields likely to benefit local geological students. The paper was illustrated by diagrams and specimens.—March 7th. Mr. J. Madison showed specimens of Rhætic shale containing Avicula and Gryphæa; Mr. A. T. Evans, pebbles from the Drift, one of Caradoc sandstone containing cup corals and various shells. Mr. H. Insley showed, under the microscope, sections of a Lancashire coal ball, showing woody cylinder and bark of Lygenodendron, and medullary rays, &c., in *Amyelon ascis*; Mr. J. Madison, *Chelifer muscorum*; Mr. J. A. Grew, *Pulex vespertilionis*.—March 14th. Mr. J. Madison exhibited specimens of *Succinea oblonga*, *Vertigo angustior*, *and V. moulinsiana*. Mr. C. F. Beale then read a paper on the "Natural History of a Trilobite." The writer described the position occupied by Trilobites in the Animal Kingdom, and remarked that they were once supposed to be represented in modern seas by *Limulus polyphemus*, but that conjecture was now a theory of the past. The bibliography of the subject was traced from their earliest mention to the present time, and though the literature of the subject had grown voluminous of late years, still some species have been found that have not yet been described. The three divisions of a Trilobite, the head, thorax, and pygidium, and their component parts, were described. Their geological range was from the base of the Cambrians to the Carboniferous Limestone; their most abundant period being the Silurian age. The alleged predatory habits of these creatures were held to be without foundation, their food being found in the mud in which they were afterwards entombed. The paper was largely illustrated by specimens, diagrams, and plates.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY.—SECTION D, ZOOLOGY AND BOTANY. Chairman, F. T. Mott, F.R.G.S. Monthly meeting, Wednesday, March 16; attendance thirteen (five ladies). Mr. John Palmer, Waterloo Street, was elected a member. The following objects were exhibited, viz., by Mr. E. F. Cooper, F.L.S., a number of large, coloured, and very excellent German plates of grasses and other agricultural plants; by Mr. Grundy, a small tray of marine shells; by Mr. H. E. Quilter, a shell of *Nautilus Pompilius*, cut through and showing very perfectly the chambers and the syphon-channel; by Dr. Finch, an extraordinary example of the creeping root-stock of the nettle, *Urtica dioica*, about six feet long, very much branched, and in some parts three-quarters of an inch thick; also, a specimen of the rook, with the lower mandible broken, and the upper one grown abnormally to three inches in length, curved and hooked. The chairman introduced a discussion on the relations between univalve and bivalve shells, the question in dispute being whether the operculum of univalves is really a second valve or an organ which has no homologue in the bivalve. Gray argues that it is a second valve, because its structure is the same, with the same spiral character, and with the spiral turned the contrary way to the other valve; but the fact that it is secreted by the foot, and not by the mantle, is opposed to this theory, and the most recent writers seem to consider that it is not a true valve. The discussion was continued by Mr. Quilter, Dr. Tomkins, Dr. Cooper, and others. The chairman then read a short paper on "The Voices of Animals," showing that voice was only possible in the air-breathing vertebrates, and was in fact only developed to any important extent in the two classes of birds and mammals.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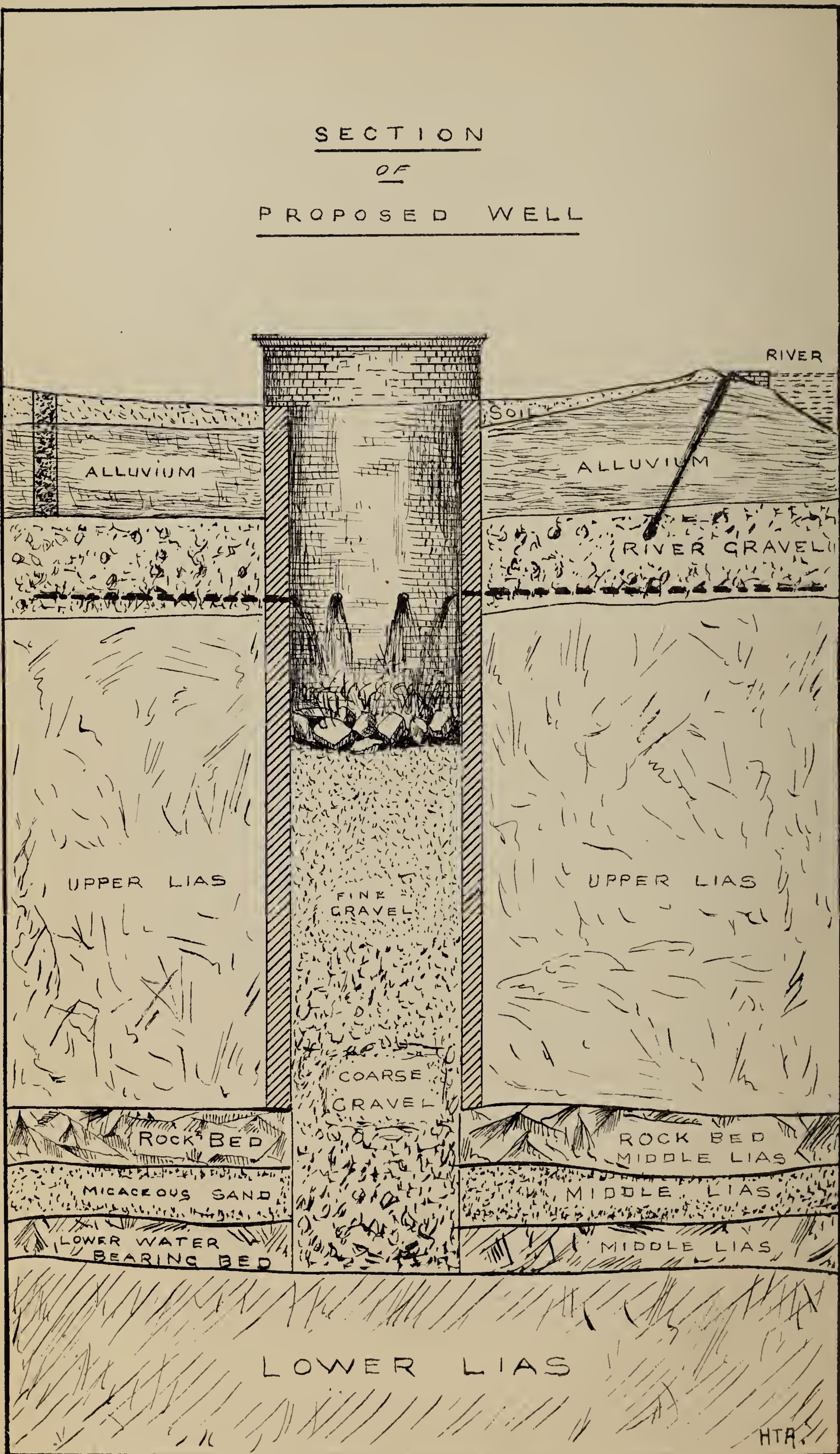
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MIDDLE LIAS
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THE MIDDLE LIAS OF NORTHAMPTONSHIRE.

BY BEEBY THOMPSON, F.G.S., F.C.S.

The Remedy.

(Continued from page 100).

There is no doubt whatever that the natural distribution of water in England has been considerably disturbed of late years by artificial means. Not being content with the quantity or purity of the water obtained from the hillside springs, or shallow wells, the deep-seated reservoirs have been tapped and pumped as though there could be no limit to the amount of water in them. Again, not being satisfied with the dryness of our fields we have artificially drained them, and so cut off some of the water which otherwise would have got into the porous beds below, and consequently at the same time helped to produce extensive and destructive floods. The particular object of the following pages is to endeavour to show how the equilibrium may be largely restored by putting into the porous beds of a district much of the water which is now naturally and artificially kept out of them, together with any additional surplus water that may be available. The details of the method proposed for the application of this in Northamptonshire are as follows:—In most of the valleys around Northampton there are times of the year when they are visited with considerable floods; many fields seem almost constantly under water in winter time, owing to the fact that they are lower than the water in the river when the river is high, and so they have nowhere to drain into. An artificial well or swallow-hole, about 100ft. in depth on the average, more to the east and less to the west, would enable this water to run away into the porous beds of the Middle Lias, where it is so much needed.

Description of Plates II. and III.

Plate II.

Section across the Nen Valley between Northampton and Hardingstone, showing the supposed arrangement of alluvium, river gravel, &c.

Plate III.

Diagramatic section, showing the general relation of proposed dumb wells to the surrounding strata.

These dumb wells would all be situated in the valleys, and would generally require to be cut through a little alluvium and river gravel, and through the Upper and Middle Lias. The wells might be lined with brick, and then filled up with coarse gravel, broken brick, or any good porous material to within 35ft. or 40ft. of the top, the material to get finer towards the top, in imitation of the filter beds of the London Water Companies. The depth of 35ft. to 40ft. not filled in with gravel is given to enable the water running in from the river gravel, as well as that from the surface, where such water is desirable, to have a good fall, whereby it may be effectually aerated before entering the chief filter bed. Some large stones might be placed at the top of the sand to prevent the latter from being much disturbed by the falling water. The river gravel is so commonly met with along the Nen Valley that very great use might be made of it in such a scheme as is here being described. Sometimes this gravel is capped by 12ft. to 14ft. of alluvium, an earthy kind of clay containing much organic matter, and very impervious to water ; at other times the gravel comes nearly or quite to the surface, but there is every reason for believing it to be a fairly continuous bed. The flat land on each side of the River Nen eastward of Northampton gives almost the exact limits of the alluvium, or river gravel, or both—that is, the part which is so liable to floods has below it a porous bed which may be utilised for the mitigation of floods. The gravel frequently extends beyond and above the alluvium, and forms a kind of fringe to the valley, as described in a previous page. (See Plate II.) Since, then, we have a porous bed, several feet in thickness, existing very little below the ground which is now so commonly flooded, it would not be a difficult matter to make a number of artificial openings into it from the surface, and fill them up with gravel, so as to put the primary well into good communication with the source of its supply—flood-water. At the present time water obtained from the river gravel is clear, and free from suspended impurities, and would still be so if this plan were adopted, so that there would be little or no silting up of the dumb wells. In some places where it might be desirable to construct a dumb well the river gravel would not lend itself for the purpose ; this would be the case in the northern branch of the Nen. The difficulty might be got over by making six or more radiating channels from the well to a slight depth, in which would be placed large drain pipes, these to be covered over with gravel and the turf replaced. The precautions here mentioned would secure the wells from any rapid silting up, although somewhat retard the flow of water, and consequently the amount that could be utilised, though at any time the upper layers of the filter bed in the well could be taken out and replaced if necessary.

As all these openings into the Marlstone would be near the river or some feeding stream, an additional and very important increase in the amount of water obtainable might be made by having a connection with the river, by means of a pipe, so placed as to draw water from this source when the river was sufficiently high for it to be well spared. It would indeed be an advantage to millers and others to be relieved of this water, and might somewhat prevent the injuries which arise to the banks from overflowing. The diagrams* will show the general nature of the proposed arrangements. The advantages which I claim for this scheme are these:— It would improve a large district now injured by floods; it would after the first season improve our water supply, and ultimately make it abundant; the water would be very pure, because it is filtered before entering the well, and filtered in the well itself before entering the most effectual filter, the bed itself; and what I consider a very important matter, the water would be well aerated by its fall; and it will be at once evident that no additional reservoir is required for the increasing amount of water, no pipes required to convey it to the pumping station, and no filtration required after pumping.

As indicating the objections that might be, and indeed have been, urged against this scheme, I propose to consider separately the following questions:—

1.—Would there be enough water?

2.—Would the water go into these beds?

3.—Would the water which goes in be available for our use?

4.—Would the water be pure?

5.—What would be the expense?

6.—Are there any special natural or legal difficulties in the matter?

I.—Would there be enough Water?

In the early part of 1885 the water supply of Northampton was estimated at 420,000 gallons per day from all sources, only about 315,000 gallons being from the Marlstone.

* The Diagram containing section of well must be regarded as one in which relative dimensions have been ignored, so that the particular features of the arrangement may be the better shown. I have to thank Mr. H. T. Armitt for preparing the drawings for me.

This supply for 60,000 inhabitants, it will be readily observed, was equal to 7 gallons per day per head; whereas not less than 20 gallons per head should be available. For Northampton alone, therefore, a daily supply of 1,200,000 gallons at least is required; and since the town is rapidly increasing, and a number of villages may also claim to be supplied by the town, owing to the character of an Act of Parliament applied for and obtained by the Water Company, certainly no less than 2,000,000 gallons per day ought to be aimed at.

The River Nen and its tributaries has a drainage area of 1,077 square miles, made up of 150 square miles of Lias, and 927 of oolite, much covered with alluvium. The drainage area above Higham Ferrers Bridge is 383 square miles.* Higham Ferrers Bridge is situated fourteen miles N.E. of Northampton, a distance not exceeding that of some portions of the Middle Lias which have in all probability acted as collecting grounds for the water supplied to Northampton in the past; for as I shall be able to show in a later section, the Marlstone area nearest Northampton has in no way contributed to the town water supply. It appears, therefore, that so far as the *average porosity of the Marlstone is concerned*, the whole of the catchment area, viz., 383 square miles, might be utilised for feeding the Middle Lias. As, however, many things might modify the available amount of water, and with any amount of care only a rough idea of the quantity could be obtained, I have tried to err on the side of caution by basing the following calculations on a supposed catchment area of 150 square miles.

The rainfall of Northamptonshire, taking an average of a good many years, is 23·1 inches per annum, and since 1 inch of rain = 22,687 gallons per acre, or 14,519,680 gallons per square mile, it follows that a rainfall of 23·1 inches over 150 square miles would give about 50,310 millions of gallons.

Of this water a good proportion is lost by evaporation from exposed surfaces, and from the leaves of plants. The amount of water evaporated in different seasons would vary considerably, and be greatest when the rainfall was most evenly distributed throughout the year; it would also be influenced by the character of the country as regards structure, hills and valleys, and the geological character of its surface. Taking these latter into account for the district under consideration, and by comparing with estimates given by more competent authorities for other districts, I think an allowance of 10 inches per annum on account of evaporation would be sufficient.

* "The Water Supply of England and Wales," by Chas. E. de Rance, F.G.S., &c.

A deduction of 10 inches of the rainfall over an area of 150 square miles would amount to about 21,779 millions of gallons.

A second loss is to be considered in the average flow of the river. According to Mr. Beardmore,* the Nen, at Peterborough, has drained 620 square miles, and its ordinary summer discharge at this place is 5,000 cubic feet per minute, which is equal to 8·06 cubic feet per minute for each square mile of area drained. This represents 1·82 inches of the rainfall, and so the contribution for the area under consideration is equal to 3,964 millions of gallons per annum.

The water which sinks into the ground and is not evaporated again need not be considered as a loss, because it all reappears as springs, feeders of the river, or accumulates in the Middle Lias, that being the lowest water-bearing bed of the district, where, of course, it is still available.

The remainder then, after deducting loss by evaporation and ordinary flow of the river, may be regarded as *flood water*, which is disposed of by the river, or along the river valley. So great is the discharge sometimes, that according to Mr. Shelford, C.E., the amount of water passing through Peterborough Bridge was on one occasion increased from the ordinary flow of 5,000 cubic feet per minute to 480,000 cubic feet per minute. All this water is to spare, and would be better disposed of in another way.

The quantity of water to spare, therefore, from the drainage of 150 square miles would be about as below:—

		Millions of Gallons.
Rainfall (23·1 inches per annum)		50,310
Loss by evaporation	21,779 millions	
,, ,, flow of river	3,964 ,,	
Total loss		25,743
		24,567

That is, a quantity of water equal to a daily supply of over 67 millions of gallons is to be had if we can only take it.

Of course I do not pretend that this amount could be impounded; indeed, a fraction of it would be ample, but the great magnitude of the surplus water must be evident to everyone.

* "Hydraulic Tables," by Nathaniel Beardmore, M. Inst. C.E. Weall, 1852. Quoted from Water Supply of England and Wales, by C. E. de Rance, Assoc. Inst. C.E., F.G.S.

(To be continued.)

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.

PRESIDENTIAL ADDRESS.*

BY R. W. CHASE.

The honour conferred in re-electing me President of this Society last year entails the duty of giving a retiring address for the second time. I can assure you I deeply felt having that important post again placed in my hands, as it assured me I still retained your confidence.

The successful career of a President is largely due to the assistance and support rendered by his colleagues on committee; I, therefore, take this opportunity to most heartily thank those members who have from time to time so kindly and cordially given me their help, thereby enabling me to complete satisfactorily—I hope—my year of office, which is one especially to be remembered on account of the meeting of the British Association, which passed off with so much éclat.

The Society is to be congratulated upon the active and important part taken by many of its members in the proceedings of that meeting, and the deservedly high eulogium passed upon their work cannot help encouraging members to continue their efforts in the hope of obtaining the same or greater results in the future.

Retrospect.

The Society during the year has lost by death two of its most valued members, and I cannot allow this occasion to pass without recording the deep regret felt, not only by myself, but by every member of the Society who knew them personally. I refer in the first instance to Mr. W. Southall, F.L.S., an ex-president, who, by his great abilities, his intimate and comprehensive knowledge of botany, his never-failing kindness in imparting that knowledge to others. his universal courtesy and geniality of manner, endeared himself to all his friends; and it was entirely owing to failing health that this Society of late years had not benefited on more occasions from his varied attainments. It is with difficulty that such a gap in any Society can be refilled; men of William Southall's character are rarely met with. The second loss was that of our honorary secretary, Mr. John Morley, F.R.M.S., who for many years past occupied that

* Transactions of the Birmingham Natural History and Microscopical Society. Read March 29th, 1887.

onerous and difficult post, in which he laboured throughout the whole period with indefatigable zeal for the welfare of the Society; in fact, he thoroughly assimilated himself with it, so that the interests of both became identical. It is probable that no one was better, or so well, known in the Society as he, on account of his general popularity and the number of years he had belonged to it. Botany was his special branch of study, and British Ferns were his especial delight. One of his chief characteristics was the courage with which he advocated his views, and however widely he might differ from his brother scientists, he was always friendly as soon as the controversy was over. His sterling good qualities caused his loss to be deeply felt by the Society, and his memory is not only respected now, but will be in years to come, as one who faithfully tried to do his best.

The work of the Society has been of a very satisfactory character during the past year, and an increased interest in the proceedings has been evinced by many members, which is most gratifying to those who labour in promoting the love of Natural Science. The financial position is slightly improved from the previous year, but to continue the usefulness of the Society it is absolutely imperative that the present income should be kept up, if not augmented, and to do this, new members are necessary to take the place of those lost to the Society, either by death or otherwise. I would, therefore, urge upon the members the desirability of bringing the advantages of the Society—which are great—before their friends as an inducement for them to join.

Popular Interest in Natural History.

The interest taken in what I may term general Natural History is, I think, more widely spread than is usually imagined. I do not refer to scientific study or systematic research, but the casual interest, or desire to know something of things, animate and inanimate, one meets with in our every-day life, without caring about the morphology and physiology of the object which attract attention. This class of interest was largely shown and exemplified by the majority of the visitors who inspected the Natural History Division of the Exhibition held in Bingley Hall, which section was of a necessity restricted, as the specimens exhibited only represented species that had been obtained in the immediate district, and consequently it was impossible to convey an adequate idea of the complete Fauna, Flora, and Geology of the Midlands. In making enquiries for the loan of specimens, I found that many rare mammals and birds obtained in this and adjoining counties were scattered about in all directions; often the solitary Natural History object possessed by the owner, which in its isolation was nearly valueless, but if forming part of a collection would be of some practical use and its individual worth greatly enhanced.

Need of a Local Natural History Museum.

From the foregoing observations I could not help lamenting that our town does not possess a Natural History Museum. In all other branches of education and improvement our town well acts up to its motto "Forward;" but as regards Natural History, I do not hesitate in saying, it neglects an important duty in not affording Nature a place wherein might be displayed and explained her wonders and beauty to the edification of the many.

It is greatly to be regretted that Natural History is not more recognised by teachers as a means of education, producing logical thought, training the mind to detect salient points, working out cause and effect, thereby showing an indisputable continuity of action connecting both. Such study cannot but be beneficial to the pupil, and in the Board Schools what an inestimable boon such lessons might become to a working man in after years, providing him with a healthy and elevating recreation. I consider myself fortunate in knowing many such instances, and could mention several in this town, who after a hard day's work devote their leisure to the pursuit of some branch of Natural History, Entomology or Geology being the favourite studies, and it is surprising what splendid results, what intimate and accurate knowledge, such men obtain, entirely by their own individual industry and perseverance, and often with little help from books. I wish such cases could be multiplied, which probably would be done if we possessed a good museum. For some time past a controversy has been going on as to the advisability of opening museums and similar institutions upon the Sunday. If I possessed the power as I have the will they should be thrown open at once, but at the same time, I advocate educating the masses so that they may intellectually enjoy, and understand a little of what they see and admire, so that all moths and butterflies should not be "Bob Howlers," and other sections of the animal kingdom be honoured with similar appellations.

The reason Birmingham is so behindhand with respect to the foundation of a Natural History Museum is rather incomprehensible. I am afraid that those who are in a position to assist in bringing about this desirable acquisition to our town associate such an institution with a collection of stuffed monstrosities or dummies placed on stands in glass cases, or perhaps the only Natural History collection they have ever taken the trouble to notice is the wretched display —although there are some good specimens interspersed amongst the others—at Aston Hall, which is nothing less than a disgrace to a community like ours. Let me assure those who may have gathered their opinions from such a display, that the Naturalists of the present day insist that specimens shall be exhibited naturally, and represented, as far as possible, as "Nature" herself ordains. I am now speaking of a public, or shall I say popular museum, not one solely for the use of students in scientific institutions, which would be formed upon quite a different basis.

This neglect of Natural History in our town is the more astonishing when we find it taken up so warmly and supported in many others; in fact, a Natural History Museum of some sort is to be found in almost every town of any size. Take for instance, Liverpool, Newcastle-on-Tyne, York, Durham, Chester, Leicester, Shrewsbury, Ludlow, Worcester, Warwick, Lichfield, Derby, Norwich, Salisbury, not to mention the Universities, and a host of other places. I grant many of them are antiquated, neglected, and useless to a Naturalist; but the reason of this is, I think, not far to seek.

Principle and Method of a Local Museum.

Provincial museums as a rule miss their purpose, owing in most instances to bad management, or, quite as often, by attempting too much — in endeavouring to illustrate the Zoology of the world instead of restricting their efforts to the immediate district; the consequence is, a miserable failure. In my opinion, such museums ought to most fully and perfectly represent the fauna, flora, and geology of their respective districts, each species that is indigenous being shown in all the metamorphoses that it passes through; in fact, giving a complete life history of both the animate and inanimate creation to be found in their neighbourhoods. Lack of material cannot be any excuse, as objects of interest are to be found almost at our very doors; only in those districts where there is a paucity of observers is there barrenness; even the very stones cry out for an opportunity to display their written pages of the world's history. If this could be carried out, local museums would occupy a much more important position than they do at present, and would attract specialists who might be engaged in studying any particular branch of Zoology or Geology, who, upon ascertaining that such a locality was prolific in those subjects of their research, would have only to visit the local museum to find a complete series of specimens illustrating such a family or genus more thoroughly than could be possibly done in our National Museum, both on account of the better facilities for obtaining specimens, and the additional amount of room that could well be assigned to each species. The reason so many local museums are the repositories of all sorts of heterogeneous matter is due to the reluctance of the governing body—generally a committee of estimable men, but who know nothing of Natural History—to refuse anything that may be offered for fear of giving offence and checking future donations. A private collector has generally to destroy his first, and sometimes his second collection, before experience teaches him what to save and how to store his treasures; but he has this advantage over a public museum: he can get rid of his duplicates and rubbish how and when he pleases, whereas the public body cannot. If the vast amount of rubbish, often an accumulation of years, could be swept away, and the collections begun *de novo*, with the good things left as a nucleus, a great improvement would soon be observable. Rarely does a museum possess a catalogue worthy of the name, and frequently the curator knows nothing and cares less about the objects placed under his care, and looks upon his office as a sort of comfortable retirement in which to end his days; and lastly, the want of funds is an always present calamity and effective stop to any progress in institutions of this kind. No doubt, you will ask, how can such a state of things be altered? Without much trouble, I think, by a committee annually elected by the local authorities, either Town Council or Local Board as the case may be, associated with, say, three naturalists nominated by the local Natural History Society or Field Club. This would enlist the sympathy and ensure the co-operation of many naturalists in obtaining specimens for the museum, at a great saving of cost; at the same time, by creating a personal interest, it would greatly assist in inducing specialists to undertake that their branch of study should be well and properly represented. This committee should be the governing body, to whom a grant should be annually made from the Museum and Free Library Rate; there should be no lavish expenditure allowed upon unnecessary glass cases and fittings; a carefully compiled catalogue, with reference number attached to each specimen, should be provided; the exhibits should be properly labelled so as to furnish general information to visitors as to habits, &c., and admission should be free. If I were called upon to arrange an ornithological collection of a district, I should only require a large room with top light, without any wall cases whatever; each species should be mounted in a box case, with dust-proof moveable back, glass front, with accessories showing the habitat of each species, the adult, ♂ and ♀, young in several stages, and summer and winter plumage should be illustrated. The cases would be made of various sizes, but capable of forming blocks when piled together, but with the lines of division level. Anyone who has seen Mr. Booth's splendid collection at Brighton cannot help being struck with the great difference between such a style as I have pointed out, and which, I am delighted to say, is fast being adopted at South Kensington, and the old-fashioned skin-and-bone sentinels placed in cases, generally so crowded as to frustrate the proper examination of any individual specimen.

Local Societies and Local Museums.

The one great reason why I advocate the formation of local Natural History Museums is, that a considerable portion of the labours of this and kindred societies may be of some practical service and lasting benefit, diffusing their knowledge for the public good, as well as leaving a legacy to the next generation of naturalists. Now most of the work undertaken at the present time is of a purely personal character, each pursuing his studies and observations for his own advancement and edification. I imagine that what delights the one will in all probability the many; and, as the results of such labours are now often lost, or scattered beyond recovery, it stands to reason that if these divided efforts could be preserved and systematically brought under the notice of the masses, a vast amount of good would be done both intellectually and morally, for few pursuits tend more to elevate the mind than Natural History.

Hugh Strickland on Local Societies.

I should like you to hear the opinions of one who sacrificed himself in the cause of Natural Science. I refer to Hugh Strickland. As to the duties incumbent upon local Natural History Societies, he says:—"The formation of clubs for the investigation of local Natural History also began to take up new ground. These are of much importance. The preservation of the condition of the present physical characters of our country will be far more dependent on them than at first sight appears. The last fifty years have made a great change in the surface of the country; population has increased; so has agricultural improvement, plantations, drainage, enclosure of waste lands, in short, artificial works of every kind. These have often completely altered the nature and aspect of the country, and, in consequence, the productions, both animal and vegetable. In parts of the North of Scotland, another cause—that great rage and fashion for "sporting," as it is termed, has influenced the distribution of the higher orders; the wild animals and birds have been reduced in numbers as 'vermin,' sometimes almost extirpated, and many will in a few years stand side by side in history with the bear and the wolf. It will be to these clubs that we shall be indebted for a record of what in their days did exist; and in the still untouched mountains and valleys we may have the discovery of insects and plants not known to our geographic range; and when the country shall have been mapped on the large scale by the Government surveyors, there is nothing that should prevent an active club to fill up in a few years a list of the productions within their beat, and so lead on to a complete and accurate Fauna and Flora of our own time and age; and generations succeeding would be able not only to mark the changes of the productions, but to judge and reason upon the effects which these now so-called improvements have produced on the climate and soil, and the fertility and increase of the latter. These clubs have yet to write the Natural History of Great Britain."

As this Jubilee Year seems to be full of germs of good intent, and the promise of spontaneous growth of all sorts of possible and impossible schemes, let us hope that it may contain one that will germinate and ultimately develop into a goodly edifice, to be the holder of a representative collection of the Natural History products of our district. I have little fear that, if only a small beginning were made, with continued efforts, our labours would eventually be crowned with success.

(To be continued.)

HISTORY OF THE COUNTY BOTANY OF WORCESTER.

BY WM. MATHEWS, M.A.

(Continued from page 92.)

Second Period, 1751 to 1800.

The history of this Period commences with the celebrated "*Flora Anglica*" of William Hudson, the first English Flora on the Linnæan system. Hudson was born at Kendal in 1730, and practised as an Apothecary in London, where he died in

1793. The first edition of the Flora Anglica, in one vol., appeared in 1762, the second, in two vols., in 1778. Two other editions were published after his death.

The first edition contains many local records; the second is much more copious in this respect; it yields, nevertheless, two only relating to the County of Worcester, viz.:—

"**Scirpus romanus,**" pp. 19—20. "Habitat in palustribus juxta Throgmorton in agro Worcesterensi. Revd. D. Sheffield."

* "**Campanula patula,**" pp. 95—96. "Prope Worcester."

As I shall often have occasion to repeat the names of plants previously recorded it will be convenient to mark such names with an asterisk (*), in order that they may be distinguished from new County records. I shall also mark with a dagger (†) records which, in my judgment, are undeserving of credit.

The discovery of Scirpus romanus, a small form of S. Holoschœnus, L., at Throckmorton near Fladbury, by Dr. Sheffield, has been discredited by the late Hewett C. Watson,* but, as it seems to me, without sufficient reason. Its discoverer, the Revd. William Sheffield, D.D., was Keeper of the Ashmolean Museum from 1772 to 1795, and Provost of Worcester College, Oxford, from 1777 to 1795. It is most unlikely that Hudson would have recorded so rare a plant unless he had been convinced of its identity, either by the sight of an actual specimen or from knowing that he could trust his correspondent.

We now pass to the honoured name of William Withering, one of the most eminent of British Botanists. From his time Botany became the study of the Physician rather than of the Apothecary. He was born at Wellington in Shropshire in 1741, passed the greater part of his life in Birmingham, where he was the principal physician, and died there in 1799. He lived for many years at Edgbaston Hall, a residence still situated in a well-timbered and picturesque park, close to the edge of the town. The first edition of his well-known "*Botanical arrangement of British Plants*," in two vols., was published in 1776, the second, in three vols., in 1787, the third in four vols., in 1796. It passed through five further editions, in four vols., after his death. The edition of 1776 contains few local records, and none relating to Worcester, and we might at once pass to the second edition were it not necessary, for the preservation of chronological sequence, to introduce the name of another author.

* Cybele Britannica, Vol. III., p. 71.

In 1781 and 1782 Dr. Treadway Nash published his two ponderous Folios, entitled "*Collections for the History of Worcestershire.*" The first vol., 1781, contains (Introduction p. lxxxix.) a list of 43 rare plants. As this is the first Worcester List of any extent I shall quote it entire, arranging the species in the order now usually adopted, and omitting for the sake of brevity the English names, times of flowering, and other remarks.

" A catalogue of some rare plants in Worcestershire, the Latin generic and specific names of which are taken from the 13th edition of the Systema Vegetabilium of Linnæus, published at Göttingen by Andrew Murray, A.D. 1774."

28. **Fumaria claviculata, L.** In rough stony places by the side of Malvern Hill above Great Malvern Town.

24. **Cardamine amara, L.** On the banks of the Avon below Great Comberton, plentifully.

25. **Cardamine hirsuta, L.** In the same place with the foregoing.

23. **Iberis nudicaulis, L.** In some old stone or gravel pits by the side of Pensham field, in the foot way.

18. **Dianthus Armeria, L.** Upon banks under hedges in a clayey soil, about Pershore, Eckington, Great Comberton, and many other places.

34. **Hypericum montanum, L.** Upon banks under hedges and by woodsides about Pershore, and on Breedon Hill.

26. **Geranium pratense, L.** Frequent in moist meadows, and amongst bushes in rough grounds.

27. **Malva moschata, L.** In like places with the foregoing.

29. **Lathyrus Nissolia, L.** On banks by the sides of woods between Pershore and Eckington.

30. **Lathyrus sylvestris, L.** By a woodside going from Pershore to Eckington.

31. **Vicia sylvatica, L.** In a thicket on the north side of Breedon Hill.

32. **Hippocrepis comosa, L.** On the south side of Breedon Hill, below the Camp.

33. **Astragalus arenarius, L.** On the south side of Breedon Hill, near the Hippocrepis above mentioned. *(This is now known as Astragalus Hypoglottis, L.)*

20. **Spiræa Filipendula, L.** On Breedon Hill above Overbury, plentifully.

21. **Comarum palustre, L.** In boggy places on the Lickey, near Bromsgrove.

19. **Sedum album, L.** On the rocks by the side of Malvern Hill, above Great Malvern town.

11. **Parnassia palustris, L.** In some low boggy meadows on the south side of Breedon Hill and eastward of Overbury.

8. **Œnanthe pimpinelloides, L.** By the sides of rills ascending the north side of Breedon Hill.

9. **Œnanthe crocata, L.** Frequent in ditches and by river sides in many parts of this county.

10. **Smyrnium Olusatrum, L.** Between Great Comberton and Woollershill, under the hedges of some enclosures near the Avon's side.

4. **Scabiosa Columbaria, L.** On Breedon Hill.

35. **Hyoseris minima, L.** In Pensham field, near Pershore, in the most barren and gravelly places. *(Now known as Arnoseris pusilla, Gaert.)*

36. **Hypochœris glabra, L.** In Pensham field with the foregoing.

37. **Carduus eriophorus, L.** On Breedon Hill.

38. **Gnaphalium sylvaticum, L.** Plentifully in rough pastures near Fladbury.

39. **Inula Helenium, L.** In great abundance on the side of Breedon Hill, in the ascent from Great Comberton.

* 7. **Campanula patula, L.** In hedges and by roadsides about Worcester, Malvern, and various other parts of the county.

14. **Vaccinium Oxycoccos, L.** In the boggy parts of the Lickey, near Bromsgrove.

16. **Chlora perfoliata, L.** In rough pastures of a stiff clayey soil about Great Comberton and elsewhere.

22. **Melissa Calamintha, L.** In woods and thickets near Malvern and elsewhere, not unfrequent.

* 5. **Cynoglossum officinale, L., var. B. folio virente.** Near the three mile stone going from Worcester to Pershore.

6. **Anagallis arvensis, L., var. flore cæruleo.** Upon Breedon Hill in a corn field at the top of Overbury Wood.

15. **Daphne Laureola, L.** In woods and hedges near Pershore, frequent.

40. **Satyrium viride, L.** In meadows and pastures about Great Comberton and Pershore, abundantly.

41. **Ophrys insectifera, L., var. apifera.** In rough pastures of a clayey soil on the south side of Great Comberton, towards Woollershill, frequent.

1. **Iris fœtidissima, L.** This grows plentifully in woods and thickets and by waysides about Great Comberton, and other places in the neighbourhood of Pershore.

43. **Iris Xiphium, L.** By the river's side near Fladbury, and some other places in this county; just discovered by the Duchess Dowager of Portland, that great admirer of Natural History.

12. **Galanthus nivalis, L.** At the foot of Malvern Hills.

17. **Paris quadrifolia, L.** In woods and thickets on the side of Breedon Hill.

* 13. **Colchicum autumnale, L.** In pastures and low meadows frequent about Great Comberton, Great Malvern, and many other places of this county.

* 2. **Scirpus romanus.** In marshy places near Throgmorton.

3. **Bromus pinnatus, L.** Abundantly in almost every rough pasture of a clayey soil in the neighbourhood of Great Comberton and Pershore.

42. **Osmunda Lunaria, L.** On the north side of Breedon Hill in several places, particularly above Woollershill in rough ground amongst the Pteris aquilina or Common Brakes.

It is not known who supplied Nash with the above list, which appears to be the work of a perfectly competent hand. Omitting the Blue Iris as a casual introduction, omitting also four plants previously noted, and including the Common Brake, it furnishes 39 new County records. It anticipated by six years the second edition of Withering to which we must now recur.

This, of which the first two volumes appeared in 1787, was edited by Dr. Jonathan Stokes, a Physician residing at Kidderminster. We learn from Mr. Edwin Lees (*Bot. of Worc.*, p. lxxxix.) that Dr. Stokes subsequently removed to Chesterfield where he died in 1831, in his 77th year. Dr. Stokes has enriched this edition with many records for the Counties of Worcester, Warwick, and Stafford, partly supplied from his own observations, partly from those of Withering, and partly by numerous correspondents, among whom Mr. Ballard, Surgeon, residing near Malvern Wells, appears to have been the most serviceable. I have abstracted those relating to Worcester and give the following list of them omitting those previously given by Ray, Hudson, and Nash, which are all included by Stokes. It must be remembered that the large Parish of Halesowen, which was in Salop in Withering's time, is now in Worcester.

(To be continued.)

SOME NEW LOCAL ROTIFERS.

By P. H. Gosse, F.R.S., Hon. F.R.M.S.

From the Transactions of the Royal Microscopical Society, December 8th, 1886.

The following species of Rotifera were discovered either too late to be included in Dr. Hudson's work, or since that work was published. They are described with brevity, but, I hope, with precision sufficient for identification and differentiation.

6. *Diaschiza* (?) *cupha.* Much compressed; dorsum squarely gibbous: foot short, scarcely protruding; toes long, blade-shaped, slightly recurved, with claws abruptly shouldered. Length $\frac{1}{124}$ in. Lacustrine.

This hunch-backed form needs fuller examination. I describe it from a single example, just dead, but not decomposed, in water sent from Birmingham. The depth, compared with the width, of the animal is remarkable. The trophi were very long, but ill-defined: in the occiput is a short brain, carrying a flat, lens-shaped red eye on its inner surface. The peculiar shape of the toes is shown at *e*. I affix a mark of doubt to the *generic* position, because I could not be *quite* sure of the dorsal cleft. (Fig. 6.*)

8. *Pterodina reflexa.* Lorica elliptical in outline, the two longitudinal halves bent upward and backward, at a considerable angle; the dorsal surface being evenly furrowed, the ventral rounded. Length of lorica $\frac{1}{220}$ in. Lacustrine.

The angular character is not noticed on a dorsal view, but becomes conspicuous in the act of turning. *P. valvata* bends its leaves *downward*, on hinges, at will. *P. reflexa* bends its halves *upward*, on a medial line which is not hinged, but permanent. It is somewhat like a butterfly, sitting, with half-opened wings, on a flower in an autumn noon. The internal structure is normal. I have found it abundant in water from Smallheath, Birmingham. (Fig. 8.)

12. *Notholca polygona.* Lorica roundly pear-shaped, truncate in front; the central pair of the occipital spines stout, the other two pairs almost obsolete: ventral plate forming a square box, with sloping, many-angled sides. Length $\frac{1}{160}$ in. Lacustrine.

A remarkable form. The dorsal plate is a half-oval, the ventral nearly flat. The latter is very peculiar: a kind of sub-cubic box, open at the summit, runs down to about three-fourths' length, and then proceeds, in pyramidal form, to a point at bottom; and this appears to contain the viscera. Each side is covered-in by a plate of two planes, but appears to be empty. On those parts of the arched dorsal plate which answer to these empty lateral chambers, run down very delicate flutings, while the broad medial part is quite clear and smooth. All the angles are distinct. The only example seen was dead, but showed a crimson eye and a normal mastax. From Kingswood Pool, near Birmingham. (Fig. 12.)

* Reference to figures in J.R.M.S., Feb., 1887, Pl. I. and II.

18. *Asplanchna eupoda.* Body globose, with a stout foot, retractile at will: rami of incus long, each armed on its inner edge with four widely-severed teeth. Length, moderately extended, $\frac{1}{52}$ in., width $\frac{1}{118}$ in. Lacustrine.

The most remarkable feature is the foot, which is, proportionally, much larger than in *A. myrmeleo.* The pincer-like rami are those of a normal *Asplanchna*, having a close resemblance to those of *A. priodonta*, save that their inner edges are not cut into saw-teeth, but beset with three distant spinous teeth, while each curved point is double. I have examined eight or ten examples, all from the canal, Small-heath, Birmingam. (Fig. 18.)

THE PRINCIPLES OF BIOLOGY.*

BY HERBERT SPENCER.

Exposition of Part IV., Chapter XV., and Appendix B.

The Vertebrate Skeleton.

BY F. J. CULLIS, F.G.S.

[ABSTRACT.]

When a little maiden, who is learning to sew, pricks a finger with her needle, so that just one drop of blood oozes out, she knows not that in that shed blood there are millions of living organisms doomed to a premature death, through so small an accident. Still less does she know that her dainty little body is a vast aggregate of beings equivalent to these, and that they are grouped, as it were, in families, and societies, and nations, all of which are compacted into the marvellous kingdom, of which she is the queen. But this multiplex nature alike of every human form and of every tree is fast becoming part of that common knowledge at which the multitude ceases to wonder.

Though not so much a matter of popular knowledge, it is very well known to the naturalist, that in many organisms there is not only a compounding of cells into tissues, and of tissues into organs, and an integration of these into the one greater and more manifest individual; but there is also a more or less perfect joining of several or many such semi-independent individuals into one larger whole. The study of the compound cœlenterates, of worms, or crustaceans, shows that

* Birmingham Natural History and Microscopical Society, Sociological Section, April 1st, 1886.

each more obvious individual is composed of twenty, or fewer, or, it may be, of very many more such less-independent though highly complex individuals, these being more or less perfectly fused into the greater unity. And probably no student of these forms has ever comprehended the structure of an earthworm, without asking himself if the jointed chain of his own backbone does not point to a like doubly-compound origin of his body, in common with those of all other vertebrates. This interesting question of "Morphological Composition" Mr. Spencer has considered in the early part of this volume, and the chapter on the vertebrate skeleton, as well as the appendix relating to the same subject, are practically continuations of that discussion.

To the great English osteologist—Sir Richard Owen—as to the famous Goethe and others, this theory of the serial origin of every vertebrate animal, commended itself as being indicated by the long succession of somewhat similar bones, and sets of bones, which constitute the principal portion of their skeletons. He taught that each member of this worm-like chain of segments is but a modification of one "archetypal" pattern, from which all the many existing varieties have been derived. The classical works of Sir Richard are dominated by this conception; and on this ground Mr. Spencer bases an adverse criticism.* At the same time he pays a willing tribute to the unrivalled knowledge, and great abilities of this most celebrated of osteologists, and acknowledges his own indebtedness both to his writings and lectures.

In opposition to this theory of the multiplex origin of the vertebrates, Mr. Spencer advances his own view, that the jointing of the backbone is not a remnant of an original compound individuality; but that it is due to later changes, which have been produced in the originally continuous cartilaginous notochord, as by ossification it became too rigid to admit of the necessary flexures without jointing.

The statement of this latter theory is prefaced by a discussion of the distribution of the strains in a beam. First, when it is depressed in the ordinary way by a load acting in one direction only; secondly, when the bending force acts alternately in opposite directions. It is shown that by these alternate bendings both the upper and lower parts of the beam are alike subject first to compression and then to tension; while there is a portion along the middle of the beam which is never stretched, but always compressed, let the bending come from which side it may.

* "Principles of Biology," Vol. II., Appendix B.

The case of a fish with its alternate bendings from side to side, as it propels itself through the water, is seen to present a sufficiently parallel case. In the animal's body, as in the beam, a central part is compressed by every movement; and this part is advantageously composed of a comparatively unyielding substance. In older types this appears as the notochord, rigid enough to resist the compressions which occur, while retaining a considerable amount of flexibility. But as size, or activity, or both increase, a more resistent fulcrum is needed; and the deposition of bone becomes gradually manifest, both in passing from lower to higher forms, and also in the course of the embryological development of the latter.

To continue in Mr. Spencer's own words (p. 204): "If, as facts warrant us in supposing, a formation of denser substance occurs at those parts of the notochord where the strain is greatest, it is clear that this formation cannot so go on as to produce a continuous mass; the perpetual flexions must prevent this. If matter that will not yield at each bend is deposited while the bendings are continually taking place, the bendings will maintain certain places of discontinuity in the deposit—places at which the whole of the stretching consequent on each bend will be concentrated. And thus the tendency will be to form segments of hard tissue capable of great resistance to compression, with intervals filled by elastic tissue capable of great resistance to extension—a vertebral column."

And in conclusion we read again (p. 208):—"Of course, the foregoing synthesis is to be taken simply as an adumbration of the process by which the vertebrate structure may have arisen through the continued actions of known agencies. The motive for attempting it has been twofold. Having, as before said, given reasons for concluding that the segments of a vertebrate animal are not homologous in the same sense as those of an annulose animal, or a phænogamic axis, it seemed desirable to do something towards showing how they are otherwise to be accounted for. . . ."

"Leaving out all that is hypothetical, the general argument may be briefly presented thus:—The evolution from the simplest known vertebrate animal, of a powerful and active vertebrate animal, implies the development of a stronger fulcrum. The internal fulcrum cannot be made stronger without becoming more dense. And it cannot become more dense while retaining its lateral flexibility without becoming divided into segments. Further, in conformity with the general principles thus far traced, these segments must be alike in proportion as the forces to which they are exposed are alike, and unlike in proportion as these forces are unlike; and so there necessarily results, that unity in variety by which the vertebral column is from the beginning characterised."

THE FLORA OF LEICESTERSHIRE.*

This year witnesses the publication of another of our County Floras, the Leicestershire Flora having been compiled by Messrs. F. T. Mott, F.R.G.S.; E. F. Cooper, F.L.S.; Thos. Carter, LL.B.; J. E. M. Finch, M.D.; and C. W. Cooper, M.B.

The last Flora of the County was that written by Miss Mary Kirby in 1850. Since that time the Rev. W. H. Coleman worked at the county, and prepared a manuscript flora, which forms the basis of the present book.

The plan of the Flora is as follows:—The first line gives the generic and specific name, with the authority for the name, followed by the census number of the species, and then by the English name. The second line gives its estimated relation to the indigenous Flora of the County, *i.e.*, Native, Denizen, Colonist, Alien, Casual, followed by its known distribution through the twelve botanical districts of the county, the records being divided into three periods—the old, which terminates with the year 1820; the middle, ending with the year 1850; and lastly, the recent period. A capital letter indicates whether the plant is Annual, Biennial, etc., and then the time of flowering is given.

The third line gives its usual habitats, the colour of its flowers, and its estimated frequency.

The following lines give the localities, such synonyms as seem important, and editorial remarks.

The Introduction consists of an account of the Botanical divisions and districts, with the recorded number of the species for each district. A geological map is appended. Then follows the Flora proper. This is printed in clear bold type—very refreshing to eyes weary with glancing over the older Floras—and with few misprints. Notwithstanding the amount of labour spent upon the county, the results, however, appear rather meagre. Leicestershire, like Northamptonshire, is probably too well cultivated to yield many treasures. The

* The Flora of Leicestershire, including the Cryptogams. By F. T. Mott, F.R.G.S.; E. F. Cooper, F.L.S.; Thos. Carter, LL.B.; J. E. M. Finch, M.D.; and C. W. Cooper, M.B. London: Williams and Norgate. Price 15s.

nomenclature followed is that of the "Student's Flora." No attempt has been made to utilise the corrections of that work which have from time to time appeared in the "Journal of Botany." A few matters may be worth alluding to. *R. Drouetii* is placed as a variety of *R. trichophyllus*; it appears worthy specific rank as much as *R. penicillatus*, Dumort., which is given as a species apart from *peltatus*, Fries.

Corydalis claviculata, DC. Here Persoon is the authority.

Barbarea intermedia is given as a variety of *vulgaris*.

B. præcox has specific rank.

Arabis hirsuta, Br. Scopoli has priority over Brown.

Sisymbrium Thaliana, Hook. It should be *Thalianum*, Gay; and *Alyssum calycinum*, Linn., should be of Jacquin. There is only one locality given for *Polygala depressa*, Wender, which would be more correctly written *P. serpyllacea*, Weihe. In the neighbouring county, Northamptonshire, it is much the commoner form. Linnæus wrote *Arenaria trinerva*, not *trinervis*, Smith being accountable for the latter word. The small flowered Lime is called *T. parvifolia*, Linn., but it should be *T. cordata*, Mill. *Sagina apetala*, Linn., should be described as of Arduini.

Radiola linoides, Gmel., should be Roth.

The name of *Geranium perenne*, Huds., is antedated by that of *G. pyrenaicum*, Burm. f. Burman also is the authority for the name *G. pusillum*. Our British *Euonymus* is much more correctly described as *Euonymus vulgaris*, Scop. The Linnæan *europæus* was made up of two species. *Medicago maculata*, Sibth., is antedated by Allione's name of *M. arabica*, if, indeed, it should not stand as of Curtis, who has beautifully figured and described it in the "Flora Londinensis" under the same name, which, by-the-bye, Sibthorp quotes as a synonym. *Trifolium medium* is of Hudson. The old *Lotus major*, Sm., stands as *L. uliginosus*, Schk.; but, as already pointed out in the "Journal of Botany," *L. pilosus*, Beeke, is the proper name.

Vicia angustifolia, Roth., is rather Reichard, and *Lathyrus macrorhizus*, Wimm., should be *L. montanus*, Bernh. *Prunus communis*, Huds., as a name for the Sloe is incorrect, if applied to the restricted plant. Hudson in his second edition so called the combined *insititia* and *spinosa*, and as such it is correctly given in the "Student's Flora;" but when the three plants, *spinosa*, *insititia*, and *domestica*, are treated as separate species, then the Sloe must be called *P. spinosa*, Linn. Ed. I. *Potentilla Comarum*, Nestl., should be *P. palustris*, Scop., Scopoli also being the authority for *Alchemilla arvensis*.

Callitriche verna, L., is described as a species apart from *platycarpa* and *hamulata*, and is said to be common. This may be so if the aggregate species be intended, but if the restricted plant *vernalis*, Kuetz, be meant, then Leicestershire must differ from every other British county. There is no record of the occurrence of *C. obtusangula*, Le Gall, which the writer has seen in the county, and which is probably not uncommon in it.

Bupleurum rotundifolium, L., is described as a chalk plant. This, although undoubtedly more frequent on limestone and chalk, is not as a cornfield weed restricted to such formations. My venerable friend the Rev. M. J. Berkeley found it in Northamptonshire, on limestone, and I believe considered it to have good claims to nativity there. *Apium graveolens* is said to be a sea-side plant, which is quite true, but there are also undoubtedly native localities inland, as in Oxon and Berks.

Apium nodiflorum, L.; Reichb. fil. is the authority, not Linnæus. Koch's variety *repens* is quoted for four localities; but it is extremely improbable that this very rare British plant should occur in all of them. It is more likely to be the var. *ochreatum*.

It is not quite correct to say that Coleman first distinguished *Œnanthe fluviatilis* from *Œ. Phellandrium*. Dillenius described and figured it in Ray's Synopsis, and in the 3rd edition of Withering it was described as var. 2. Coleman was the first botanist to give it a binomial term.

The record of *Galium sylvestre*, Poll., if the plant be correctly identified, is very interesting. *Valerianella olitoria*, Mœnch, was first described as a *Valerianella* by Pollich. Hudson, not Linnæus, is the authority for *Dipsacus sylvestris*. *Symphytum tuberosum*, L., if native, is an interesting record. *Mentha piperita*, Huds., was first described by Linnæus in Ed. I. Spec. Plant. *Calamintha officinalis*, Mœnch, should be *C. montana*, Lamk., as *C. Nepeta*, Clairv., should be *C. parvifolia*, Lamk., and *C. Acinos*, Clairv., *C. arvensis*, Lamk., all these being described in Flor. Franc. by Lamarck previously to the names above quoted. *Prunella* is rather pedantically changed to *Brunella*, but, as Mr. Daydon Jackson points out, *Prunella* is the name we should use.

Lamium intermedium, Fries, is recorded for one locality. Has this plant been verified by competent authority? It is a great extension of the geographical range of the plant.

Specific rank might as well have been given to *Atriplex deltoidea*, Bab., as to a hybrid thistle. *Alnus glutinosa*, L., was described by Linnæus as a *Betula*; Gærtner was the first to call it an *Alnus*.

Is the identity of the Linnæan *Salix incubacea* with Ehrhart's *ambigua* satisfactorily made out?

No notice is taken of Mr. Beeby's *Sparganium*, and Hudson is quoted as the author of the species. The writer has seen *S. ramosum*, Curtis, in the county.

Brown wrote *Eleocharis*, not *Heleocharis*.

Scirpus carinatus, Sm. This, if authentic, is a peculiar extension of the range of the plant.

Alopecurus agrestis, Linn., was originally named *A. myosuroides*, by Hudson in the 1st edit. of "Flora Anglica." *Trisetum flavescens*, Beauv., is rather *T. pratense*, Pers.

Under *Glyceria distans* there is no notice of the var. *obtusa* mentioned in Babington's "Manual" as found in Leicestershire, although more than two pages are occupied with the description of the forms of *Capsella Bursa-pastoris*. The records in the Record Club reports also have not all been worked into the text.

It is stated that the *var. loliacea*, Curt., of *F. pratensis*, Huds., is now considered to be a hybrid. This is the form which has the honour to be included in two places in the edition of the London Catalogue, *i.e.*, under *Festuca pratensis*, where it is described as of Huds., and also under Lolium as a hybrid of that species with Festuca, *i.e.*, *L. festucaceum*, Link. The Leicester Flora asserts that Hudson's *Festuca loliacea* is a shore plant with shorter spikes, which is certainly not the case, for in the first edition of Hudson it is described as occurring in fields near London, and is the hybrid already alluded to. Hudson's *Poa loliacea* is the shore plant, and has been confused in the London Catalogue with the *Festuca*. The proper name for the maritime grass, as a glance at the "Enumeration" of Kunthe will show, is *Festuca rottboelloides*. Since Hudson's time it has been shifted about from *Poa* to *Triticum*, to *Glyceria*, to *Sclerochloa*, and now to *Festuca*. The old genus *Triticum* should be spelled *Agropyron*, not *Agropyrum*.

After the Flowering plants and Ferns come the Cellular Acrogens, the Mosses numbering 179 species. Oxford has 193 species on record.

A large number of Fungi, Lichens, and Algæ are enumerated.

About thirty Phanerogams and Ferns are stated to have become extinct.

In the summary the Flora of Leicestershire is compared with the Flora of Warwick, and with that of the British Isles. It shows that of Flowering plants, and Ferns and their Allies, Warwick has 1,017 species, Hampshire 1,136, and Leicestershire 891, the British Isles having 1,610. The latter number is decidedly underestimated. Warwick and Hants are quoted as if they had no Cellular Acrogens and Thallogens. The statement that Leicester is richer in proportion to its area than Warwick, and very much richer than Hampshire, is rather misleading. As a county it cannot compare favourably with Warwickshire, and is not to be mentioned in the same page as Hampshire, which is peculiarly rich not only in the number of its species but in the rarity of so many of them.

On the whole the compilers of the Flora are to be congratulated upon producing the County Flora; many of the editorial notes are suggestive, and the table of plant distribution through the county is distinctly useful. With respect to the colour of the flowers being given, it may in some instances prove of service; but the statement that the flowers of *Veronica hederæfolia* and *V. arvensis*, are both *pale blue* is not likely to assist in the diagnosis of those species. *Galeopsis speciosa*, Miller, is said to be pink and white, which leads one to suppose the true plant (the *versicolor* of Curtis and the *cannabina* of Pollich) has not been seen in the fresh state by the recorder. Nor does bluish white quite convey to the mind's eye the colour of *Nepeta Cataria*. *Galeopsis Tetrahit*, in Northants, is as frequently found with pink or white flowers as with "yellowish."

G. Claridge Druce.

MIDLAND UNION OF NATURAL HISTORY SOCIETIES.

The Annual Meeting is arranged to be held at Malvern on Wednesday and Thursday, the 6th and 7th of July. The meeting will be held on the 6th, and the 7th will be devoted to Excursions in various directions, of which further particulars will be shortly communicated to the Societies in the Union.

Thos. H. Waller, Hon. Sec.

METEOROLOGICAL NOTES.—March, 1887.

The barometer was high at the commencement of the month, reading 30·592 inches on the 2nd, but there was a gradual, though interrupted, diminution of pressure till the 19th, when a rapid fall took place, and on the 23rd the reading was 28·869 inches (the lowest). A rise ensued, and another fall at the close of the month. The mean temperature was above two degrees below the average, both the maxima and minima being lower than usual for the month. The highest readings occurred on the last few days. On the 29th, 59·4° was registered at Loughborough, 58·5° at Henley-in-Arden, 57·4° at Hodsock, 56·9° at Southwell, and 55·3° at Coston Rectory; on the

27th, 56·0° at Binley Vicarage. In the rays of the sun, 121·2° at Hodsock, on the 12th ; 109.3° at Loughborough and 104·5° at Southwell, on the 27th. The lowest readings were 16·3° at Coston, 20·0° at Binley Vicarage, on the 13th ; 18·8° at Hodsock, 20·7° at Southwell, on the 20th ; 21·0° at Henley-in-Arden, on the 13th, 14th, and 19th ; and 21·5° at Loughborough, on the 21st. On the grass, 11·3° at Hodsock, on the 18th ; 16·3° at Southwell and 16·6° at Loughborough, on the 17th. Rainfall was about half an inch below the average, the amounts measured being 1·61 inches at Coston Rectory, 1·59 inches at Binley Vicarage, 1·54 inches at Henley-in-Arden, 1·44 inches at Southwell, 1·30 inches at Loughborough, and 1·29 inches at Hodsock. The values in twenty-four hours in no case exceeded half an inch. The number of "rainy days" varied from sixteen to twelve. Snow fell at Loughborough on seven days. The customary March gales were rather "conspicuous by their absence" till the end of the month. Sunshine about the average. WM. BERRIDGE, F. R. Met. Soc.

12, Victoria Street, Loughborough.

Wayside Notes.

VISITORS TO THE BRITISH ASSOCIATION MEETING last year will remember the excitement over Mr. E. B. Poulton's five-toed cats, while his far more interesting communication on the gilding of chrysalids did not attract nearly so much attention. This latter series of investigations he has since been continuing, broadening out into experiments on the protective value of colour and markings in insects, especially in Lepidopterous larvæ, in their relations to vertebrata. He has found that conspicuous insects are nearly always refused by birds and lizards, but that they are eaten in extreme hunger ; hence the unpleasant taste which conspicuously-coloured insects possess failed as a protection under the circumstances. Further, conspicuous and unpalatable insects, although widely separated, tended to converge in colour and pattern, being thus more easily seen and remembered by their enemies. In the insects protected by resembling their surroundings it was observed that mere size might prevent the attacks of small enemies. Some such insects were unpalatable, but could not be distinguished from the others. In tracing the inedibility through the stages, he found that no inedible imago was edible in the larval stage ; the unpleasant taste arises therefore in this latter stage.

AT A RECENT MEETING OF THE PHYSIOLOGICAL SOCIETY OF BERLIN (March 25) Prof. Falk gave an account of some recent investigations into the influence of extremes of temperature upon the colour of the blood. In persons either burnt or frozen to death the *post mortem* patches present a strikingly bright red colour. He has found that temperatures of 0° C. (freezing point) and below lead to the colour of the blood becoming bright red by causing the oxygen of the air to be more readily fixed and more stably retained by the blood corpuscles than is the case at ordinary temperatures. If, however, the blood has stood exposed to the air until putrefactive changes have set in, in this case the action of cold no longer makes the blood brighter in colour. Other experiments have shown that in animals killed by low temperatures the blood is bright red, not only in the peripheral parts but also in the heart and great vessels. Also in human beings frozen to death the blood even in the heart is sometimes observed to be bright red, although in most cases only the blood in the peripheral parts presents this appearance ; probably death has ensued from freezing only in the first of these two appearances. These researches may not improbably have some future bearing in medical jurisprudence.

Botanists everywhere will watch with some interest the progress of an experiment upon which the Corporation of the city of Glasgow has just entered in assuming control of the grand botanical gardens at Kelvinside. These gardens, which were started in 1816, were the property of the shareholders in the Boyal Botanic Institution, by whom they have been maintained, with the assistance of occasional grants from different sources for special considerations. They include twenty-three acres of ground, and have a collection of glass structures second perhaps only to Kew. The society has been, however, financially overweighted by them for many years, and now, in liquidation of a debt to the Corporation of £46,000, has handed the property over without any reserve or conditions to the Corporation. Fortunately the city of Glasgow is governed by a body of eminent public spirit, far removed from that mercantile littleness which is the bane of many corporations, and there seems little doubt that the Corporation will preserve in its entirety their new property. A curious difficulty has, however, cropped up, in that the gardens are situated in a suburb which is outside the municipal boundary, and a bill to annex which, though practically unopposed, has been thrown out by a committee of the House of Lords. It is unlikely that this will affect the result, especially bearing in mind that a botanical garden is an essential appendage to a university, and the whole weight of the university influence of Glasgow is thrown into the scale in favour of retention.

Still another "Naturalist," and this time connected in name as well as in fact with a religious body. The "Wesley Naturalist," with the Rev. W. H. Dallinger, F.R.S., Rev. W. Spiers, M.A., and Rev. H. Friend, F.L.S., as editors, has been started as the monthly organ of the Wesley Scientific Society. In his editorial Dr. Dallinger tells us that a study of Nature may, under certain circumstances, become a moral obligation. Perhaps we should ourselves be inclined to go a step further and mention that the study of Nature is, under all circumstances, excepting the absence of the various sensory organs, a moral obligation. At least, that is our reading of the parable of the talents.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—Microscopical Meeting, April 5th. The president, Prof. W. Hillhouse, M.A., in the chair. Mr. Walliker sent for exhibition, *Oxytheria stictica*, Linn., a beetle found amongst flowers from France. Mr. W. B. Grove, B.A., exhibited for Mr. Hanson a number of specimens, prepared by Mr. English's process for preservation of fungi, by powdered plaster of Paris, dry, and some preservative solution washed over; also, on behalf of Mr. Westwood, a double orange, one growing within the other. Mr. W. H. Wilkinson then read a paper on "Colour Re-action: its use to the microscopist and biologist." After pointing out the great advantages to the biologist, by the use of colour re-action, in studying the continuation of a given tissue, or tracing the course of a vascular bundle, or in revealing the structure of otherwise too transparent tissue, he illustrated the effects by placing under a series of microscopes specimens, plain and stained in several different ways. He then referred to the value of colour re-action in lichenology, both in showing the structure and in assisting in classification, and then showed the effect by causing three lichens to become three different colours, viz,, yellow, red, and purple, by touching them with the chemical reagents. He further illustrated the paper by carefully prepared and coloured drawings.—Biological Section, April 15. Mr. R. W. Chase in the chair. A paper was read by Mr. A. Bernard Badger, of New College, Oxford, on "Phosphorescence in the Animal Kingdom," illustrated by an extensive series of coloured slides which were exhibited in the lantern by Mr. C. Pumphrey. The display of phosphorescent light in living animals was described and illustrated, from the minute marine infusoria (*Noctiluca*) that cause the luminous appearance of the surface of the sea, the sea-pens (*Pennatula*), and many other marine animals, to the glow-worms and fire-flies of this country and tropical climates. The emission of the light appeared to be the result in all cases of some external excitement or irritation; and it was considered to be produced either by a slow oxidation or combustion of some fatty or oily matter, or some conversion of nervous energy into light energy. The latter hypothesis appeared very questionable; but the former one was supported to a remarkable extent by the discovery from microscopical examination in the majority of cases of special phosphorescent organs containing stores of minute fatty or oil globules.—Geological Section Meeting, April 19. Mr. T. H. Waller, B.A., B.Sc., in the chair. Exhibition of specimens: Mr. Bolton, the plasmodium of a myxomycete in active motion, in form, like a very large amœba from three to four inches long, from near Sutton; Mr. W. B. Grove, the three earliest leaf fungi of Spring, viz., *Œcidium ficariæ*, *Uromyces ficariæ* (both, in some instances, on the same leaf), and *Puccinia adoxæ*, all from Water Orton, gathered on Easter Tuesday; on behalf of Mr. Iliff, *Daldinia concentrica*, from Aldwinckle, Northants. Mr. John H. Lloyd, M.A., exhibited specimens of gold ore from Australia and New Zealand. Mr. Waller, B.A., B.Sc., read a note on the occurrence of gold at Mount Morgan, near Rockhampton, Queensland. Votes of thanks were accorded to both the above gentlemen for their interesting specimens and notes thereon. The secretary, on behalf of Mr. W. R. Hughes, read a paper (by Mr. A. H. Cocks), on "Chillingham Wild Cattle;" the paper was illustrated by photographs. The secretary was directed to convey to Mr. Cocks the thanks of the section for his note and illustrations.—Sociological Section, April 26th. Mr. W. R. Hughes, F.L.S., in the chair. Mr. J. H. Salter, of Queen's College, was unanimously elected a member of the Society, and a paper was read by Mr. Hughes on the fifth and sixth chapters of Mr. Herbert Spencer's "Data of Ethics," treating of the physical and biological aspects of conduct. At supplementary meetings on April 7th and 21st, papers were read by Miss Byett and Mr. F. J. Cullis, F.G.S., on the second portion of Mr. Spencer's "Factors of Organic Evolution."

CARADOC FIELD CLUB.—The Annual Meeting was held at Shrewsbury, on Tuesday, March 29. In the unavoidable absence of the president the chair was occupied by T. P. Blunt, Esq., one of the vice-presidents. The minutes of the last annual meeting having been confirmed and the treasurer's accounts approved, the Rev. J. D. La Touche was re-elected president, and G. R. Jebb, Esq., was elected a vice-president, in place of W. E. Beckwith, Esq., who retired by rotation. The Rev. P. B. Brodie, president of the Warwickshire Field Club, was also elected an honorary member. Field meetings for the ensuing season were fixed as follows: Larden Ditches (Wenlock Edge), May 27; Malvern (long meeting), at the date of the meeting there of the Midland Union of Natural History and Scientific Societies; The Breidden, August 10; and Pulverbach (for Cryptogamic Botany), September 23.

Fig 1. *Jet from 10 Lead Discs.*

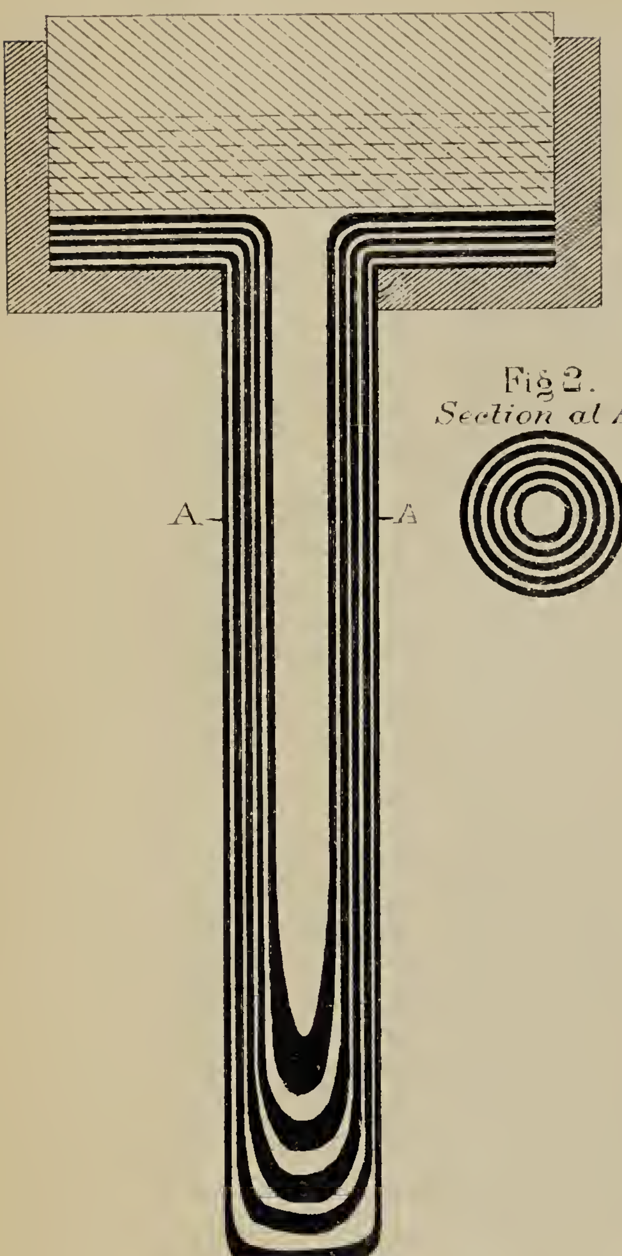


Fig 2.
Section at AA.

Fig 3. *Jet from 4 Lead Discs.*

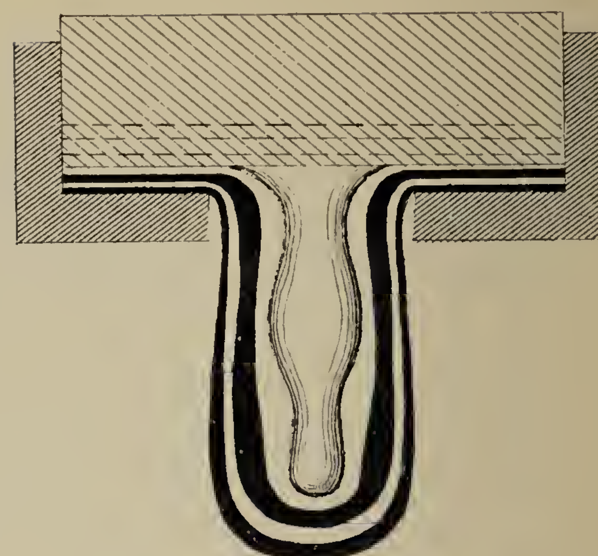


Fig 4. *Jet from Shallow Water.*

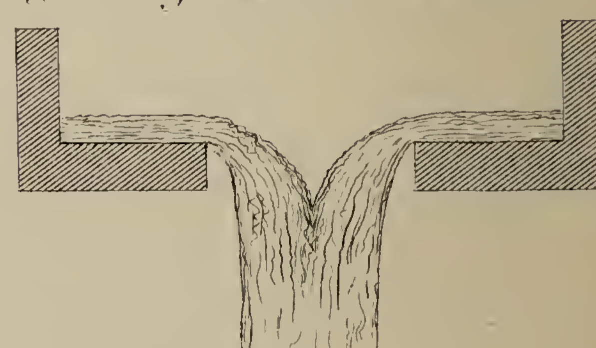


Fig 5. *Compression of 20 Lead Discs.*

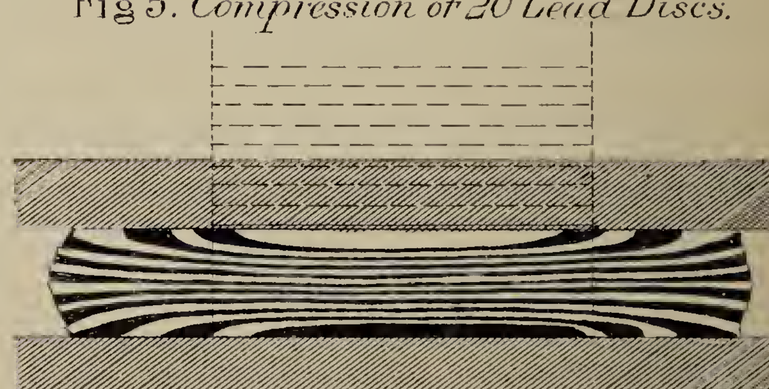


Fig 6. *Double Jet.*

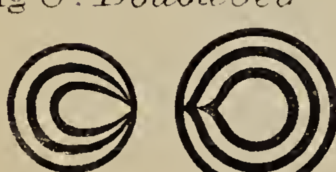
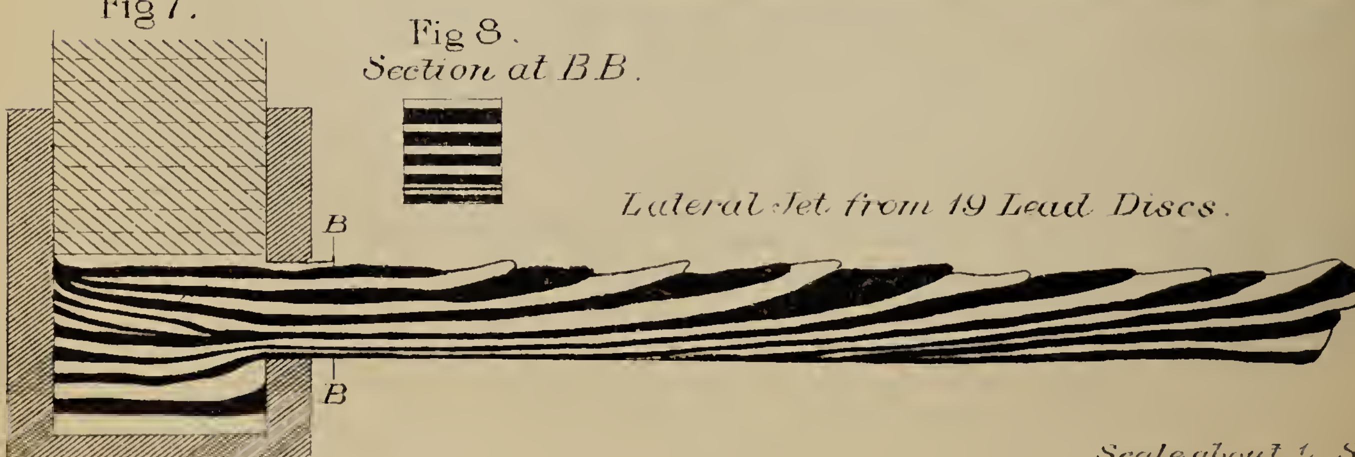


Fig 7.

Fig 8.
Section at B.B.

Lateral Jet from 19 Lead Discs.



Scale about 1/2 Size

W. P. Marshall del.

FLOW OF SOLIDS.

Herald Press Lith

ON TRESCA'S REMARKABLE INVESTIGATIONS INTO THE FLOW OF SOLIDS UNDER GREAT PRESSURES.*

BY W. P. MARSHALL, M.I.C.E.

The application of pressure to solid bodies is ordinarily looked upon as producing simply consolidation in the body under pressure, making it more dense and hard; but this is only true within the limits of ordinary pressures, and when sufficiently high pressures are applied such bodies become plastic and yielding, and with an extremely high pressure the harder metals and even steel itself can be squeezed into new forms, and made to behave similarly to a lump of clay. We are indebted for the knowledge of these facts to the remarkable investigations of the late M. Tresca, the talented director of the "Conservatoire des Arts et Métiers," at Paris, who made a long series of experiments in many very ingenious forms for the investigation of this subject, and carried out important practical applications of the results in improvements in the mode of making sound iron forgings.

The first series of these experiments was made upon lead, as the softest and most ductile of the metals; the lead to be compressed was placed in a circular metal cylinder, shown in Fig. 1, Plate IV., which had a round hole in the centre of the bottom, and a circular ram, fitting the cylinder closely, was then gradually forced down upon the lead in the cylinder, by placing the whole in a hydraulic press, exerting a very great pressure uniformly over the upper surface of the lead. The lead being rigidly supported by the sides and bottom of the cylinder everywhere excepting opposite the hole in the bottom, that hole was the only point in which it could yield to the pressure; and it was found that as the pressure was increased the lead began to bulge outwards at the hole, and presently protruded through the hole, forming ultimately a continuous cylinder the same diameter as the hole, and several times longer than the original mass of lead in the cylinder. In fact, the metal was made to *flow* through the hole by the application of a sufficient amount of pressure, forming a solid jet, just as a soft body such as clay would flow through the hole under a moderate pressure, or a liquid would flow through under the pressure of gravity alone. An extreme case that was tried was a set of discs

* Transactions of the Birmingham Natural History and Microscopical Society, June 24th, 1884.

2in. diameter that were forced through a hole only $\frac{1}{8}$in. diameter, which made a continuous jet of as much as 23ft. length, consisting entirely of concentric tubes.

In order to examine the process of the flow amongst the different particles of the lead, the ingenious plan was devised of making the original mass of lead in a series of thin flat discs, all of the same dimensions (like a pile of penny pieces), their touching surfaces being dusted with chalk to prevent the discs adhering together when under the severe pressure of the experiment, so that they could be taken apart again for examination at the close. The result was found to be that each of the original discs preserved its separate individuality throughout the severe ordeal of forming the long jet; and the jet was found to be composed of a series of successive layers or coats, each one fitting over the following one like a glove over a finger, and the whole showing a beautifully symmetrical figure when cut open longitudinally along the centre line of the jet. This is illustrated in Fig. 1; the successive layers being shown alternately black and white; and in Fig. 2 is shown a transverse section of the jet taken at the point A A in Fig. 1.

When this process comes to be examined, it is seen that no other result could indeed have occurred, because a uniform force applied simultaneously to all the discs must produce a uniform result in all of them, and they have really no alternative but to follow one another regularly through the hole, as the only escape possible from the overpowering force that is urging them forward.

Another form in which the experiment was tried was by having a *square hole* in the *side* of the pressure cylinder at a little distance from the bottom, as shown in Fig. 7; instead of a *round* hole in the centre of the *bottom* of the cylinder. The result found was that instead of a cylindrical jet being formed as before, consisting of a series of concentric envelopes, a square lateral jet was formed, composed of a series of flat horizontal layers of different lengths, overlapping one another; the discs directly opposite the orifice being caused to flow out at once in a continuous flat ribbon, and the discs that were originally above the orifice then following on successively in the same course, as they became one after another brought down to the level of the orifice by the gradual compression of the whole mass. In Fig. 8 is shown a transverse section of the jet taken close to the orifice at the point B B in Fig. 7.

An interesting point to notice is the behaviour of the different discs according to the position in which they happened to be situated as regards the lateral orifice at the time that the pressure was first brought to bear upon them. The effect of the pressure showed most at the bottom edge of the orifice, and the several discs that were originally situated between the top and bottom of the orifice became at last reduced down to very thin layers at the bottom edge of the orifice, by the crowding of the upper discs as they were successively brought down and caused to flow out at the orifice. This action taking place only at the front, or the point of escape, those discs that are so excessively reduced there in thickness retain much more of their original thickness at the back of the cylinder, whilst on the contrary the uppermost discs have their back edges left thinner than at the front, by the compressing ram causing the top surface of the last disc to be kept level throughout.

Another point of interest is that although the pressure at the bottom of the cylinder is uniform over the whole surface of the lowest discs that are below the level of the orifice, the effect produced upon them is modified by the circumstance of the discs above them being in a condition of flow towards the orifice, and the front edges of the lower discs are deflected upwards towards the general line of flow, in consequence of the pressure lessening gradually towards the point of escape.

A remarkable modification of the result obtained in the first experiment, Fig. 1, with the central orifice in the bottom of the cylinder, was shown when the total supply of lead discs was reduced in number, as in Fig. 3, so far that the quantity of material present under compression in the cylinder was not sufficient to fill up the jet solid. The singular result was then obtained of a jet that neither filled up the orifice close on the outside, nor was solid in the inside; and in the flow of the lead through the orifice there was obtained a central hollow and a *contracted jet* on the outside. This bears a striking analogy to the well-known *contracted vein* that occurs when a liquid flows out through a similar central aperture, as in Fig. 4; and the flow of the jet of lead has to be looked upon as differing from the flow of a jet of liquid only in the degree of pressure that is required to produce this flow, for which gravity is sufficient in the case of a liquid, but a very high pressure is required in the case of the metal.

From the circumstance of the metal jet being composed of a series of successive concentric layers, a valuable opportunity is afforded by the separate examination of these layers for ascertaining the relative motions and lines of flow of the different particles composing the jet, and of studying the action of the forces controlling their flow and their mutual interferences with one another; such an examination being impracticable in the case of a liquid jet. It will be noticed that all the particles of the material under pressure have a tendency to move towards the orifice, for the purpose of yielding to the pressure, but only those particles that are actually opposite the orifice are able to flow directly outwards, whilst the others beyond that region and surrounding the orifice have first to move laterally in a radial direction towards the orifice, before they can get a chance of escaping. These lateral movements of the particles interfere with one another, and those from opposite sides of the orifice are directly opposed to each other, whilst the particles from higher levels move in oblique funnel-shaped directions towards the centre of the orifice. The result is that a general oblique direction is given to the particles in passing through the opening, forming a funnel-shaped centre to the hollow jet in the case where the total supply of material was not sufficient for maintaining a solid jet. This is exactly what occurs, as is constantly seen, in the case of a liquid flowing through a centre orifice (such as out of the plug opening at the bottom of a basin); when the depth of the liquid gets so low that the head or pressure is not sufficient to maintain a solid jet, a funnel-shaped hollow gets formed in the centre, as in Fig. 4, which increases in diameter as the depth and pressure become less. The liquid jet is also contracted round the outside, in a similar manner to the metal jet, and it cannot be got to fill up the entire diameter of the orifice through which it flows.

This is a very interesting point, showing that a *loss of pressure* takes place, whenever the matter is put in motion and caused to flow; and this loss of pressure may be carried so far under special circumstances of deficiency in supply of material for following up the flow, as to actually become *negative* pressure and produce a hollow.

When the orifice in the lead jet experiment was *not central*, but eccentric, there was found to be a circular displacement added that gave a torsional movement to the jet; uniform equilibrium being disturbed by the preponderance of metal that had to flow towards the jet on the thick side. An analogous effect in water jets is shown by the spiral movement that is set up in water flowing out of an orifice in the bottom of a vessel, which has the central effect of its position upset by some lateral disturbance of the surface of the liquid.

A *double orifice* in the bottom, namely, two orifices of different sizes side by side, gave very interesting results; the smaller orifice yielded a shorter jet, on account of the greater freedom of flow through the larger orifice, and the concentric layers of each jet were distorted towards the side facing the other jet, and drawn towards that side, as shown in the sections of the two jets in Fig. 6.

Further, a centre large orifice was tried with *six smaller orifices* arranged round the centre one in the position of the six angles of a hexagon; and the result was that instead of circular central jet, one of hexagonal character was obtained, having hollow grooved sides with projecting rounded angles towards each of the surrounding six holes, showing the disturbing effect of the simultaneous flow of material from the centre of the mass towards each of those six holes.

The experiments that have been described were all made in *closed* cylinders, and the compressed material had consequently no means of escape except through the special orifice provided; and experiments were also tried in an *open* unconfined space, with a similar pile of lead discs compressed between two flat surfaces, as shown in Fig. 5, leaving the edges of the disc free to expand laterally. The middle discs of the whole pile flowed outwards the most freely, and became consequently the thinnest at their centre; and the extreme top and bottom discs, being retarded in their flow by the friction against the compressing surfaces over which they had to flow, became curved and distorted in their form by the pressure of the other discs, this distortion gradually diminishing symmetrically towards the middle discs.

The above experiments were then repeated with harder metals than lead, and it was found that with all of these, and even with steel itself, the same law of flowing under pressure applied, provided that the pressure was sufficiently increased in proportion to their hardness.

I had the opportunity of witnessing some of Tresca's experiments that have been described; and the drawings from which the Figs. in Plate IV. have been copied I made direct from the several experimental pieces described; otherwise I should have hesitated to give full credence to the extraordinary results obtained.

The special practical application that was made by Tresca of these results was in improvements in the modes of forging and working iron; by so arranging the dies and tools that the metal was enabled to flow in a continuous solid stream during the process of changing its form under the hammer or press, so as to produce thoroughly sound work. It was known before from general experience that unsound forgings are liable to be made from want of care and skill on the part of the workmen, and these defects sometimes proved very inconvenient and uncertain, and involving a dangerous risk of subsequent breakage; but the matter was not properly understood till Tresca showed the real action that produced this unsoundness, and consequently the means of preventing its occurrence. The force of the blows in forging iron (that is, both the weight and the velocity of the hammer) must be proportionate to the mass operated upon; if this force is too light, the exterior portion gets drawn more than the core, leaving the ends of the forging concave, and causing unsound places or even hollows in the heart of the forging, such as a hole or "piping" extending many inches up the centre of an axle from each end. On the other hand, if the blows are too heavy, the opposite effect is produced, and the central portion is elongated more than the exterior; the unsupported material in the centre being squeezed out at the ends in a convex form, whilst the surface is held back by the hold of the hammer and anvil faces, as in the experiments of discs compressed without supporting walls, shown in Fig. 8.

It will be seen that these valuable experiments have an important bearing also upon other investigations, such as the geological changes that may have taken place in the underlying portions of the earth's crust, from the enormous pressure of the mass above them, or the lateral thrust produced by the contraction of the earth's crust—a pressure so enormous that it may possibly have been sufficient, if only a few miles, depth of superincumbent rock is considered, to reduce to a plastic and flowing state even the hardest of the rocks of which the earth's crust is composed; and the ingeniously varied forms in which Tresca's experiments were carried out may assist in understanding the phenomena that are observed in some of the remarkable contortions of the strata forming the earth's surface.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.

PRESIDENTIAL ADDRESS.

BY R. W. CHASE.

(Continued from page 120).

Changes in Local Faunas.

A strong reason for the formation of Natural History Museums without delay is that in the course of a few years many of the forms of animal life which are now common will either become very rare or quite extinct in some districts, making the obtaining of specimens almost impossible. This is not to be wondered at when we consider the invasion of bricks and mortar which has been carried on for so many years, obliterating and absorbing so large an extent of our rural tracts that, instead of country lanes and hedgerows resounding with the song of birds and hum of insect life, we now have paved streets and rows of houses, still resonant, but with a music of a totally different kind—a change, in many respects, not for the better. Again, the improved communication between place and place consequent upon the enormous growth of our railway system, far and away greater than the loftiest conceptions our forefathers had the slightest idea of, has been the means of opening up many quiet haunts, dear to the heart of mammal and bird, but also delightful to the overworked man of science or artisan of our towns, which previously for generations were left unmolested and uncared for; but this intrusion has been the cause of driving the original denizens further afield to regions still more remote. From various sources, such as household books, bills of fare of ancient banquets, and the like antiquarian records of a bygone age, we find that many birds, now extremely rare, or conspicuous by their absence, were formerly common.

I purpose, therefore, making a few remarks as to the probable causes of the decrease of many of our native birds. That such is the case, I think no one will dispute; species that formerly were abundant, and bred regularly in suitable localities, are now only met with as occasional stragglers to our shores. It is worthy of remark that those birds whose habitat is swampy marsh lands or dense reed beds are the least adapted, or at all events give one that impression, to accommodate themselves to any altered conditions of life; consequent upon the draining of the fens, many were driven from this country and betook themselves to the Dutch marshes, where they still remain. It is highly probable that our indigenous birds were always being supplemented more or less from the opposite coast, therefore it was natural for them to leave our uncongenial land for that better suited to their requirements, possessing, as many of them would, an inherent predisposition to return hither. No one who is conversant with the physical geography of our Eastern counties could help noticing the alteration that is even now going on in still further reducing the area of marsh and fen. Two causes are at work to effect this: the increase of pumping mills, and the "existence of the fittest" in the botanical arena—first reed, then bullrush, afterwards the common rush, and eventually grass, which is used for herbage, and, I am told, possesses extraordinary feeding qualities. The different style of farming adopted of late years has had a material influence upon many species of birds. The transformation of arable land into permanent pasture has been carried out to a very large extent in some parts, in the anticipation and hope that producing meat and dairy products will prove more profitable to the agriculturist than growing corn—hence the granivorous genera have been compelled to partially migrate to obtain necessary food, their place being occupied by soft-billed or insectivorous species; hence we find the sudden and abnormal increase of a certain species in one locality and decrease in another. I have often noticed that the country seems mapped out into districts or divisions, and that each has its complement of birds allotted to it. In case one of these divisions become depopulated from some cause or another, the void is immediately filled by some adjacent species, consequently we find the geographical range of a particular species often altered without any very definite reason, unless the hypothesis I have just given solves the problem. Again, the undue felling of timber throughout the country has a very great tendency to prevent the increase of bird life, as destroying means of shelter; also the laying or grubbing up of hedgerows. A good old-fashioned hedge of hazel or thorn, often yards through, with thick bottom of undergrowth—sacred spots to a sportsman—are objects of the past on a scientifically worked farm; but such afforded excellent cover for birds to construct their nests in, and gave every chance of successfully rearing their brood without discovery by their various enemies. The reclaiming and enclosing of common, or so called waste land, has also helped to bring about this decrease. The natural enemies of birds are strong and numerous. I have seen them enumerated somewhat as follows:—Their own brethren, polecats, stoats, rats, cats, and hooded crows, to say nothing about boys, collectors, and the *genus homo* generally. Undoubtedly the vicissitudes of bird life are many, and at frequent periods the struggle for existence is both sharp and severe. The elements are important factors to be considered and taken into account whencalculating destruction of life, as severe cold, continued frost, wind, or excessive wet, will deal death wholesale, especially if such calamitous conditions occur during the breeding season or migration. Last spring I had two instances brought most vividly under my notice. The first was the flooding of Rockcliffe Marsh, near Carlisle, where Skylarks, Meadow Pipits, and Dunlins breed in very considerable numbers. I saw dozens of nests, many on the point of hatching, that had been covered with water and totally destroyed. The result was that many birds forsook the place, and only very few young were reared by those who nested the second time. The other instance was the destruction of Swallows, Martins, and Sandmartins by a gale of wind in April last, which killed thousands, and was pretty general throughout the country, as reports all testified to the same result; in many instances dashing them against walls and buildings. An eye-witness informed me that at the foot of an engine-house wall at one of the reservoirs you might have filled a bushel measure with these dead birds. There is little doubt that, owing to the cold weather, food was scarce. These Hirundines were therefore weak, and unable to cope with a gale of this magnitude; some I examined were in a most emaciated condition, and had every appearance of being starved.

Enormous loss of life occurs during migration from various causes; the lanterns of lighthouses claim their tale of victims, many being attracted by the light, and striking the glass, kill themselves. Telegraph wires are often the means of destruction, and very effectually they do the work; I have seen birds, some of large size, nearly cut in two by a wire. The improvement in guns has had a material effect in reducing the number of birds, especially since the introduction of breech-loaders; but this case would apply chiefly to the slaughter committed at our marine breeding stations, where such birds as the Guillemot and Razor Bill abound, who in ages past were practically unmolested by man, and simply had to provide for the larders of a few Peregrine Falcons that might occupy the same cliff. I think it can safely be said that in Great Britain at all events, for many years past, circumstances hostile to the increase of birds have greatly increased. Not only are birds at the present time compelled to combat against those evils that naturally exist, and always have co-existed with themselves, but they have also the inventions and scientific adjuncts of this civilized age to contend with, which leaves the bird beaten in every encounter and at all points. To remedy this state of affairs, several Acts of Parliament have been passed at various times for the protection of birds, but before touching upon them I should like to refer to one or two species whose extermination in this country can be traced directly to the actions of man and to him alone. Notably, the Great Auk comes first, which became extinct about 1845, and the last British specimen, according to Yarrell's "British Birds," Vol. iv., p. 64, "was taken alive at the mouth of Waterford Harbour in May, 1834, and is now preserved in the museum of Trinity College, Dublin." This bird was never common on our coasts, but would possibly have continued to exist until the present, if not interfered with by man, because its large size and breeding stations inaccessible to any animal likely to prey upon it, combined with its powers of diving and swimming, gave it a good chance of holding its place in our avi fauna; but on the other hand, laying only one egg, the reproduction of the species was consequently slow, and could not long withstand any serious slaughter or destruction of eggs, without a diminution in numbers and eventual extermination, which has been accomplished. The final extinction of the indigenous race the Great Bustard is not a mere matter of history, for men are now living who well recollect seeing flocks of these handsome birds frequenting the sandy waters of Norfolk and Suffolk; the date when the last of the Norfolk birds was killed is given by Stevenson in his excellent work, the "Birds of Norfolk," as 1838, but it is likely that one or two continued to exist in that county until 1845. Anyone interested in this species cannot do better than read the article I have referred to, as the details of their being done to death by swivel guns and others placed like artillery in position to sweep a certain spot, where tempting food was laid, is fully set forth by the author in a most circumstantial and comprehensive manner; a pattern to all ornithologists who attempt to write a biographical account of local bird life.

The decrease in "Birds of Prey" is certainly attributable to man, as, on account of game preservation, any of the Hawk tribe are lucky if they rear their young without being detected by the vigilant eye of a keeper, who would soon make short work of what he would term "vermin." It is rather curious that in olden times laws were made to protect the different Falcons adapted for "Hawking," a pastime for kings and nobles, whereas at the present time the order is reversed, and game laws are enforced to protect what formerly fed the Falcons.

The Protection of Wild Birds.

Owing to the decrease of Wild Fowl, which constituted an important article of food and of some commercial value, an Act for the Protection of certain Wild Birds during the breeding was passed in 1872, fixing as close time from March 15th to August 1st for the species included in the schedule attached. The compilation of this list is a masterpiece, and certainly gives one the idea that lots were drawn whether a name should be included or not. This Act proved of little use, so an Act for the Preservation of Wild Fowl was passed in 1876, the schedule of which, I think, was framed from an edible point of view, as few species were included that were not of some gastronomic value. This Act, as well as that of 1872, and the Sea Birds Act of 1869, were repealed in 1880 by an Act entitled "The Wild Birds Protection Act," and I cannot do better than quote the brief summary from the "Zoologist," 1880, p. 437: "A close time is provided *for all birds* between the 1st of March and the 1st of August. Those species which are mentioned in the schedule may not be killed during the close time, under a penalty not exceeding £1; those not mentioned in the schedule may not be killed under a penalty (for the second offence) of a sum not exceeding 5s. and costs. In the case of the latter class the Act does not apply to the owner or occupier of the land on which any of these birds may be killed, or to any person authorized by owner or occupier. In other words, if any owner or occupier deems it desirable to keep down Sparrows, Hawks, Jays, Hooded Crows, Wood Pigeons, or any other bird which he may consider destructive he may destroy them on his own land, or authorize some one else to do so." That this Act has done an infinite amount of good in affording protection to many birds during the breeding season is no doubt the case, as the increased number of Blackbirds and Thrushes in the suburbs of the town will testify, for before the passing of the Act, any one might see numbers of nests containing young exposed for sale during the season in the Market Hall—a sale now stopped. It is a very debatable question whether it is desirable to allow such genera as Gulls, Gannets, Auks, Terns, &c., to increase and multiply to the extent permitted by nature, for while many fishermen affirm they are even now too numerous, and that the destruction of fish by such birds seriously affects their industry, others advocate the birds being protected, as they render good service in pointing out the shoals of fish, and also devour much fry of those species who would in their turn prey upon the herring; they also give notice by their cries when a boat approaches the rock, which at once tells the crew to sheer off.

The amount of good done by insectivorous birds, which form the most numerous class, to vegetation in keeping within due bounds insect life is incalculable, and, as Brehm put it, "to permit the insect world to make undue headway would amount to destroying Nature, for, in that case, the plant world on which her existence depends would cease to exist. The whole remaining creation combined would not be able to arrest the destruction caused by insect life so effectually as birds."

The Protection of Birds' Eggs.

That the decreasing number of birds is an important subject is duly testified by the attention that has been bestowed upon it by various Legislatures, not in this country only, but in our colonies; also in America and Germany. The protection that was intended to be provided by the Act of 1880 is minimised by the omission of a most important and essential feature—the protection of the eggs. I venture to affirm that it is from the taking of eggs that birds are more likely to be reduced than by the adults being shot—the gun tax was the best bird protection act ever passed and ought to be more rigidly enforced—as it stands to reason that a visitor to a breeding station of Gulls, for example, could, if so disposed, easily take 100 eggs. It is argued they will lay again, and that in the neighbourhood of these breeding stations the eggs are used as an article of food, and that the gathering of them finds work for several men. No doubt the birds will lay again after being robbed, to have the operation repeated the second time, and when any young are afterwards hatched the period is too short for them to be able to fly before the close time expires, when indiscriminate and brutal slaughter takes place, answering no legitimate purpose whatever.

The Bearded Tit, of quite different habits to the gulls, is fast becoming exterminated, entirely through the undue taking of the eggs. One marshman will take in the restricted area this species now occupies in Norfolk 200 eggs in one season, whereas I am certain from my own experience he would not be able to shoot 25 in a twelvemonth; besides, it would not pay him to give so much time in obtaining them, as no bird is more difficult to put up from the thick reed beds to obtain a shot, and the chances are you cannot find the bird when down.

The importance of taking eggs as a means of reducing the numerical strength of a species, relative to the time that species would cease to exist, is obvious, because, supposing a bird lays 100 eggs during its natural life, producing on an average five at a clutch, and if two broods were reared annually, the producing powers of the bird would last ten years, but if compelled to lay three clutches per annum instead of two, by the taking of the eggs her period of reproduction would be reduced to about seven years; therefore, the time of the extinction of a species simply resolves itself into a sum of the rule of three. It is well known that as often as eggs are taken the parent will continue laying until her strength is exhausted, so strong is her maternal desire and innate impulse to perpetuate her race.

Those species which benefit man by the destruction of insect life and are of some importance in the economy of Nature mostly migrate to our shores for the purpose of rearing their progeny, and as young birds should be hatched simultaneously with the supply of caterpillars and other larvæ to sustain them, it is obvious if the first lots of eggs are taken the time of hatching is delayed—if it takes place at all—and the outcome is that insect life obtains the chance of multiplying abnormally. Moreover, it is absolutely necessary that the young should be hatched at the appointed time to enable them to get full grown and sufficiently robust to withstand the perils of a long sea flight to their winter quarters. The like remarks, of course, apply to those species that winter here, and it is quite as desirable that they should have protection extended to them in their far-off homes likewise, to enable a strong contingent to migrate here, after their breeding season is over.

I fear that to an unusual number of eggs being taken in Norway and Sweden we must attribute the diminished numbers of Fieldfares and Redwings of late years. Of course, in a thinly-populated country birds have a much better opportunity of escaping molestation than in one so densely crowded as ours, but the increased facilities for travel, and the "Briton's" propensity for bringing back some trophy of his excursion, has somewhat equalised the apparent advantages formerly enjoyed in those countries where Nature reigned supreme.

I think I have clearly demonstrated that it is important that eggs should have the same protection afforded them as the birds themselves; an egg to appearance is dead, but it contains the elements of a future life, which lies dormant until stimulated to action and growth by the application of the proper degree of warmth, which quickly produces evidence of existing life; and, if I may be allowed such an expression, I might say eggs are simply birds held in suspense.

If I have made out a case I ask those members who may have the leisure and opportunity to take notes during the coming season, and judge whether I am right in advocating the protection of eggs; if so, then what more fitting duty could a Natural History Society perform than in urging upon those who are in a position to further such an alteration in the law as would tend to save from final extermination, or at all events lighten considerably the present struggle for existence. Without some such help many of those species will become fewer and fewer which now assist so materially in adding to the charm and delight of forest, moor, hedgerow, and field, to say nothing of how bird life contributes to make the desolate sea shore interesting.

Such restriction would in no way interfere with the student of Ornithology if our Government would follow the example of Canada, and grant licenses to those who are *bona fide* Naturalists and could produce credentials that they were engaged in making a collection for the purpose of study or science. Ornithology is the only branch of Natural History that is hampered by legal restriction of any kind. If an International Conference of Naturalists could be arranged to take into consideration the whole question of bird protection, its deliberations would be of immense assistance in arriving at some definite and uniform action, although the various issues to be discussed cover so large an area; still, whatever decision might be arrived at, it could not be otherwise than reciprocal to those who took part therein, and prove beneficial to them individually.

I regret that I have not been able to bring before your notice an address more in accord with your tastes, but the subject I have introduced is not necessarily confined to ornithologists, but should be of some interest to every lover of Nature. Thanking you for the patience with which you have listened to me, I must now leave the solution of the problems of a Natural History Museum and the Protection of Eggs to the future.

HISTORY OF THE COUNTY BOTANY OF WORCESTER.

BY WM. MATHEWS, M.A.

(Continued from page 124.)

SECOND PERIOD, 1751 TO 1800.

Stokes in Withering. Edit. 2., Vols. 1 and 2, 1787.

N.B.—The explanatory remarks in italics are by the present writer.

Myosurus minimus, p. 336. Malvern Chace. Ballard.

Ranunculus aquatilis, δ, 578. In shoals in the Severn. St.

This is the plant now known as R. fluitans, L.

Ranunculus Lingua, 572. Bogs on Malvern Chace. Ballard.

R. parviflorus, 577. Malvern Hill. Ballard. Worcester. St.

Helleborus viridis, 581. Orchard near Mr. Ballard's, Robinson's End, Malvern Chace. Mr. Welles. Ballard.

Aquilegia vulgaris, 562. Souston's Rock, near Shelsley. Ballard. St.

Nymphæa lutea, 554. River Avon at Pershore. Ballard. Mr. Waldron Hill.

* **Fumaria claviculata**, 753. Rough stony places above Great Malvern Tower. Nash. Ballard.

Lepidium ruderale, 672. Rubbish on the side of the Severn above Worcester. St.

" Tower" must be a misprint for " Town." See the record in Nash.

Cardamine impatiens, 685. On loose earth thrown up from a quarry above Lench Ford, nearly opposite Shrawley, and in Cliffy Wood near Hanley. St.

* **Cardamine amara**, 689. About Worcester. St.

Sisymbrium sylvestre, 691. On the banks of the Severn near Worcester. St.

S. amphibium, 692. Side of the Severn near Worcester. St.

Sinapis nigra, 714. Banks of the Severn. St.

Reseda Luteola, 492. About the ruins of Dudley Castle. With.

Viola tricolor, β. 957. Blossoms blue, blue and yellow or blue and white. About Stourbridge. St.

Drosera rotundifolia, 331. Malvern Chace on the side of the rivulet flowing from the Spa. Ballard.

Saponaria officinalis, 438. Hedges near Hanley. Ballard. St.

* **Dianthus Armeria**, 440. Clarkton Leap, near Worcester. St.

D. prolifer, 441. In a marle pit, Landridge Hill, Hanley Castle. Ballard.

Stellaria uliginosa, 457. Rivulets on the side of Malvern Hills, and on the side of the Hill at W. end of Powick's Ham, near Worcester. St.

Arenaria tenuifolia, 461. Malvern Hill. Ballard.

Alsine media, 324. Form with 10 stamens. In hedges near Worcester. St. *(Stellaria media. With.)*

Sagina apetala, 170. On a wall belonging to the Almshouse near St. Oswald's, Worcester. St.

Hypericum Androsæmum, 812. Lanes at the foot of Malvern Hill. St.

H. humifusum, 814. Ronk's Wood, near Worcester. St. Malvern Common. Ballard.

Geranium moschatum, 725. Near Stourbridge. St.

G. maritimum, 725. Sandy commons between Enville and Bewdley, Worcestershire. Mr. J. A. Hunter.

G. sylvaticum, 727. Near Halesowen. With.

Malva sylvestris, 739. Vars. 2 and 3. Near Worcester. St.

Rhamnus catharticus, 239. Side of a brook near Hanley Castle. Ballard. Near Worcester. St.

Anthyllis Vulneraria, 765. Limestone Pits, Cradley, near Malvern Hill, Worcestershire. Ballard.

Cradley is in Hereford, but it is quite possible that the Limestone pits may have been in Worcester, where (in Mathon parish) the Anthyllis may now be found.

Trifolium repens, var. proliferum, 793. Worcestershire. St.

Lotus corniculatus, var. tenuissimus, 805. In the neighbourhood of Worcester. St. (*Lotus tenuis. Kit.*)

Vicia sylvatica, 774. Woods about Clifton-on-Teme, in moist places. St.

V. bithynica, 779. Woods near Clifton-on-Teme. St.

Lathyrus latifolius, 772. Severn Stoke Copse. Ballard.

* **Sorbus domestica**, 514. In the middle of a thick wood in the Forest of Wire, near Bewdley, Worcestershire. One mile from Mopson's Cross, between that and Dowles Brook, found by Mr. Pitts, Alderman of Worcester. Ray, Nash, St.

* **Spiræa Filipendula**, 518. Near Madresfield. Ballard. Frequent in the neighbourhood of Worcester. St.

Potentilla argentea, 532. Side of the Turnpike road in the Parish of Holt Castle. Ballard.

* **Rosa rubiginosa**, 520. Between Dudley and Tipton. St. In Mr. Terne's garden, Worcester, from a gravel pit near Claines Church. St.

* **Rosa spinosissima**, 522. Hedges and ditch banks about Worcester. St.

Sedum Telephium, 465. Fields about Robinson's End, Malvern Chace. Ballard.

S. reflexum, 466. Malvern Hill. Ballard.

Cotyledon Umbilicus, 464. Malvern Hill. Ballard. In the clefts of rocks above Great Malvern. St.

Saxifraga granulata, 434. Bevere, near Worcester. St.

Chrysosplenium alternifolium, 404. Purlieu Lane, leading from the Wych to Mathon. Ballard.

* **Parnassia palustris**, 325. In Worcestershire. St.

Apium graveolens, 316. Moors, Samsom Fields, Worcester. St.

Pimpinella magna, 314. Worcestershire. Ballard, St. "In marle." St.

Anethum Fœniculum, 311. Near Spetchley. St. (*Fœniculum officinale, All.*)

Sium latifolium, 292. In the Moors, near Pitchcroft, Worcester. Dr. Thompson, junr.

Sison inundatum, 295. Sides of rivulets on Malvern Chace. Ballard.

* **Œnanthe crocata**, 297. Meadows near Hanley Hall. Ballard.

Phellandrium aquaticum, 298. Clifton, near Severn Stoke. Ballard. St.

Scandix odorata, 303. In an orchard at the top of Souston's Roche, near Shelsley Walsh. Ballard. St. *(Myrrhis odorata, Scop.)*

S. Cerefolium, 304. Found near Worcester in considerable plenty on the south-east side of the Bristol Road, just beyond the Turnpike, May, 1775. And in the hedges in Upper and Lower Old Swinford, though not to be discovered in any of the neighbouring gardens. St. *(Chærophyllum sativum, Lam.)*

Smyrnium Olusatrum, 310. Found by the Rev. Mr. Welles at Hill Croome. Ballard. St. And Pirton plentifully, Mr. Hollefear.

Viscum album, 1112. Worcestershire, on Apple trees, sometimes on Limes, and in one instance on a Plane tree, near Lord Coventry's menagerie, Croome. St.

Adoxa Moschatellina, 417. Purlieu Lane, Mathon. Ballard. Between Stone and Mitton. St.

Viburnum Lantana, 318. Ripple Field. Ballard.

Galium Mollugo, 155. Malvern Hills. St.

G. scabrum St., 155. Hedge row in a marly soil on the side of Red House Lane, near Worcester. St. *(A var. of the preceding.)*

Asperula odorata, 158. At the Leasows near Halesowen. With.

Dipsacus pilosus, 138. Abbey Lane, Evesham. Ballard.

Hieracium sabaudum, var. 4, 850. Perry Wood, near Worcester. St.

(H. boreale Fr.)

* **Carduus eriophorus**, 875. Hill End Bank in Longdon Parish. Ballard. On the footway between Clarkton Leap and Kemsey. St.

C. pratensis, 877. Swampy meadows near Robinson's End, Malvern Chace. Ballard. St.

Anthemis arvensis, 937. Pastures about Asscote and the Stewponey, near Stourbridge, Worcestershire. St.

The Stewponey is in Stafford, but the plant is frequent on the Worcester side the county boundary.

Vaccinium Myrtillus, 394. Rocks above Great Malvern. Ballard.

Erica Tetralix, 398. Hartlebury Common. Ballard. Worcestershire. St.

E. cinerea, 399. In the N. of Worcestershire. St.

Chironia Centaurium, 237, var. 3. Blossoms white. Upper Battenhall, near Worcester. St. *(Erythræa Centaurium, Pers.)*

* **Chlora perfoliata**, 392. Side of Malvern Chace. Ballard. Edge of the Ridd Cliff. St.

Atropa Belladonna, 233. Dudley Castle. With. St.

Verbascum Lychnitis, 225. Kinver, Stafford, near the Rock-houses. St.

I have inserted this record as the plant grows in Worcestershire very near this locality.

V. virgatum, 228. First shown me by my late worthy friend, Mr. Waldron Hill, of Worcester, in a field on the S. side of a lane leading from Gregory's mill to the Turnpike road near that town. The side of the Turnpike road from Worcester to Ombersley, opposite to the lane leading to Beverley. St.

Digitalis purpurea, 655. Blossoms white. Shenstone Lane, near Hartlebury. St.

Antirrhinum Orontium, 650. Worcestershire. Ballard. St.

Veronica montana, 13. Wood at the west end of Powick Ham, near Worcester. St.

Orobanche major, 658. Shrawley Wood. Ballard. On a dry bank near Clifton-on-Teme. St.

Mentha Pulegium, 602. Side of a pool at Robert's End, near Hanley Castle. Ballard.

Galeobdolon luteum, 611. Hedges near Malvern Chace. Ballard. Woods near Worcester. St.

Anchusa sempervivens, 192. Near Birmingham on the Alcester road. With. Near the Blanketts, Worcester. Ballard. St.

Pinguicula vulgaris, 16. Broadmoor, about 3 miles S.W. of Birmingham. Mr. Brunton. On the N.W. side of the Malvern Hills, but not on the S. or S.E. sides. Ballard.

Lysimachia vulgaris, 208. By the side of the Avon, at Pershore. Ballard.

Samolus Valerandi, 221. Side of the brook running from the brine pit on Defford Common. Messrs. Ballard and Hollefear.

Plantago media, 143, var. 2. Leaves with straw-coloured stripes. Hawford Bridge in Worcestershire. St.

Rumex maritimus, 371, var. aureus. Severn Stoke. Ballard. St.

Rumex Hydrolapathum, 374. About Clifton. Ballard. St.

Polygonum Bistorta, 406. Ham Green, near Mathon, and Martley. Ballard.

P. Hydropiper, 408. Malvern Chace. St. (*See under P. minus, p. 210.*)

P. minus, 410. Gravel Pit on Malvern Chace. St.

P. pensylvanicum, var. petechiale, 412. In a ditch on Stourbridge Common. St.

P. pallidum, var. 3. Curtis. With., 3rd Edit., 381.

Quercus Robur, 1084, *β*. Acorns on long fruit stalks, 1086. Little Shelsley. Mr. Hollefear. (*Q. pedunculata, Ehrh.*)

Taxus baccata, 1130. Numbers scattered over the country between Stourport and Abberley. Clearly an indigenous tree. St.

Zanichellia palustris, var. *β*., St., 1014. Brooks and Pools near Worcester. St.

Lemna gibba, 1020. Lower Bishop's Pool, Northwick, near Worcester, and in a Pool near the East side of Malvern Chace. St.

Acorus Calamus, 357. River Avon, near Pershore. Ballard.

* **Paris quadrifolia**, 416. Wood near the Devil's Den, Clifton-on-Teme. Ballard. About Frankley. With.

Butomus umbellatus, 420. Side of the River Avon at Evesham. Ballard.

* **Galanthus nivalis**, 340. At the foot of the Malvern Hills on the right side of the road running below the camp, where no traces of any buildings or gardens are to be found. Ballard in Bot. Arr., Ed. 1. Finstall near Bromsgrove. St.

Narcissus Pseudo-Narcissus, 342. In Orchards, Hanley Castle. Ballard.

Allium vineale, β. with a double head of bulbs, 344. Near Worcester. St.

Hyacinthus non-scriptus, 356. Var. 2. Blossoms white. Near Worcester. St.

* **Colchicum autumnale**, 379. In orchards on the borders of Malvern Chace. Ballard. On the Meadows bordering the Severn. St. Halesowen. With.

Orchis latifolia, 976. Between Battenhall and Worcester. St.

* **Ophrys apifera**, 994. Tedstone near Whitbourne, Worcestershire. Ballard.

Tedstone itself is in Hereford, but very near the county boundary.

Serapias longifolia, 998. Swampy Meadows, Robinson's Street, on the borders of Malvern Chace. Ballard. (*Epipactis palustris. Sw.*)

S. grandiflora, 1000. Mr. Knight's Walks, Wolverley. St.

Juncus sylvaticus, 364. Witchery Hole near Clifton upon Teme. Ballard. St. (*Luzula sylvatica, Bichen.*)

Scirpus palustris, var. β., 46. Severn Stoke. St.

Scirpus acicularis, 47. Malvern Chace. St.

Carex pulicaris, 1026. Malvern Chace. Ballard. St.

C. disticha, 1028. Boggy Meadows on the side of Malvern Chace. Ballard. St.

C. pendula, 1046. Witchery Hole near Ham Castle. St.

Nardus stricta, 54. Malvern Chace. Ballard.

Phalaris canariensis, 65. New's Wood adjoining to Malvern. Ballard.

Poa cristata, 91. On the edge of a Marle Rock, Clarkton Leap, near Worcester. St. (*Kœleria cristata, Pers.*)

Festuca ovina, 97. Malvern Hill and Chace. Ballard.

F. sylvatica, 102. Worcestershire. St. (*Brachypodium sylvaticum, R. and S.*)

Bromus secalinus, var. 3, **hordeaceus**, 104. Near Kempsey and Ridd Green. St. *Now considered a var. of B. mollis. See Eng. Bot., 3rd Ed., Vol. XI., p. 170.*

B. mollis, 106. Var 2, nanus. Barren soil near Stourbridge.

B. madritensis, 107. Severn Stoke. St.

124 plants are enumerated in the above list. Of these, 15 are repetitions of species previously recorded; 2 are varieties of other species; and 2, Anthemis arvensis and Verbascum Lychnitis, cannot be claimed as Worcester records. After making these deductions we have 105 new records to the credit of Dr. Stokes.

(To be continued.)

Reviews.

A Junior Course of Practical Zoology. By A. Milnes Marshall, M.D., D.Sc., M.A., F.R.S., assisted by C. Herbert Hurst. London: Smith, Elder, and Co.

The want of such a work as this has long been felt both by teachers and students, as the well-known "Elementary Biology" of Huxley and Martin does not treat of several animals, the structure of which it is important that a beginner in Zoology should know thoroughly well. Its appearance, therefore, will be heartily welcomed by Zoologists.

The book opens with some very valuable instructions on methods of study, which ought to be well taken to heart by every beginner; those on dissection, in particular, being extremely good and to the point. The remarks in this and the last chapters on the preparation and use of reagents are also very useful.

The body of the book is composed of directions for the examination and dissection of the following animals: Amœba, Paramœcium, Opalina, Vorticella, the freshwater Hydra, Liverfluke, Leech, Earthworm, fresh-water Mussel, Snail, Crayfish, Cockroach, Lancelet, Dogfish, Rabbit, and Fowl. This list, it will be seen, contains the types which it is most important a beginner should understand, with the exception of that of the Frog; Professor Marshall has, however, previously described this animal in a former work which it would be advantageous to have incorporated with the present volume. The treatment is admirable: full directions are first given as to the dissection necessary to expose an organ, and then follows a description of the latter and of its relation to neighbouring structures. In order to attract attention to them, the directions are printed in italics, whilst a system of indentation has been used to render the subdivisions of the descriptions more distinct. Some structures which present special difficulties have been treated at great but not undue length, whilst others, such as the muscular system, which the author regards as of subordinate educational value, have, owing to the short time usually available for laboratory work, been almost entirely omitted.

Although the book is essentially practical, yet the "morphological salt" of which Professor Michael Foster speaks has been plentifully scattered throughout its pages. This is a valuable feature, and the explanations of anatomical details will be of great use to the student in enabling him to gain a connected view of the various facts which he learns from his dissections.

There are some forty-eight illustrations; more have not been introduced, as it is strongly and rightly insisted that the student should make them for himself from his own preparations. Many of those given are new and have been specially drawn for the book. They are for the most part very good, but exception must be taken to those of *Vorticella*, and of the section through the body-wall of *Hydra viridis*, the former being greatly wanting in detail, and the latter being crude in execution. Those, however, of sections through the *Crayfish*, *Mussel*, *Snail*, and *Amphioxus* are exceedingly good and useful. Last, but not least, comes a very full and accurate index, while the printing and paper are all that can be desired.

There seems to us to be only one point in which this work is wanting, and that is in the absence of any bibliography of standard monographs on the various animals considered. The author may perhaps fear that students would copy the illustrations given in such works, instead of drawing their own preparations; that difficulty, however, could be easily obviated by the teacher, while the advantage of having good illustrations to which to refer, especially of the histology of the animals—a subject somewhat slightly treated by Dr. Marshall—is very great.

In conclusion, we heartily recommend this book to all teachers and students of Zoology, and hope that it will have the wide sale it undoubtedly deserves.

British Fungi (Hymenomycetes). Rev. John Stevenson. *Vol. II., Cortinarius—Dacrymyces.* Wm. Blackwood and Sons, Edinburgh. Pages 1—336.

This is the completion of the work which has been so long looked forward to by British mycologists. Armed with this volume and its predecessor, the student of our larger Fungi is in a position to face the coming Autumn campaign with an assurance of success such as few in this country can have ever felt before. Especially will this volume be useful in regard to the difficult genus Cortinarius, for as all know, it is in this group that we find so many species which ordinary fungus collectors are totally unable to refer to their proper names. Still, with the full and faithful descriptions here afforded, this hitherto almost hopeless task can be satisfactorily accomplished.

But it must be confessed that the moment we leave the Agaricini and travel beyond the limits of Fries's "Monographia," from which work our author has translated these descriptions, we have to fall back upon the bald, deceptive, and irritating diagnoses of older days. A more serious complaint, however, can be founded on the fact that the present volume does not contain, as an appendix, the descriptions of those species which have been discovered as British since the author despatched his manuscript to the printers. In these fast-living days the number of new discoveries rapidly increases, and it has already amounted to about three score among the Hymenomycetes alone, since that apparently rather distant period. Are the mycologists of the north so far removed that they receive no tidings of what is being done by their brethren of the south?

The illustrations of this volume are as good as in the last, but the glossary, from which so much was expected, is meagre and decidedly disappointing. It seems to have been framed on the principle of leaving all the hardest words unexplained, while those which, of course, a student of the Hymenomycetes would necessarily be acquainted with, such as "gills," "cæspitose," "annular," "crenate," "obovate," "mycelium," and "zoned," are here most carefully embalmed.

W. B. Grove.

METEOROLOGICAL NOTES.—April, 1887.

Atmospheric pressure was variable during the month, and its range considerable. The highest reading of the barometer was on the 17th, 30·691 inches; the lowest, on the 24th, 29·281. Temperature was about three degrees below the average, the deficiency being especially noticeable in the minimum readings. The highest observed were 68·0° at Henley-in-Arden, on the 18th and 19th; 63·6° at Loughborough, on the 12th; 63·1° at Hodsock, and 60·8° at Coston Rectory, on the 18th. In the rays of the sun, 121·7° at Loughborough, on the 6th, and 119·4° at Hodsock, on the 24th. The lowest readings were 24·5° at Coston Rectory, on the 17th and 30th; 24·6° at Hodsock, on the 18th; 26·0° at Henley-in-Arden, on the 15th; and 28·1° at Loughborough, on the 30th. On the grass, 16·4° at Hodsock, on the 17th, and 22·1° at Loughborough, on the 15th and 17th. Rainfall was below the average, and at some stations the largest portion fell on the 26th. The total amounts collected were: Henley-in-Arden, 1·30 inches; Loughborough, 1·15 inches; Hodsock, 1·01 inches; Coston Rectory, 0·88 inches. The number of "rainy days" varied from 8 to 13. Sunshine above the average. North-easterly winds were prevalent. There was a slight thunderstorm at Loughborough, in the afternoon of the 23rd, and snow fell on the night of the 26th.

Wm. Berridge, F.R. Met. Soc.

12, Victoria Street, Loughborough.

[Mr. Berridge, we regret to say, informs us that he will not in future be able to continue the monthly "Meteorological Notes," which for so long have appeared in the "Midland Naturalist." We take this opportunity of thanking Mr. Berridge for his valuable services, which we can assure him have been very heartily appreciated by ourselves and our readers.—Eds. "Mid. Nat."]

Wayside Notes.

The Memorial to the late Thomas Edward, the Banff Naturalist, has, we much regret to learn, received so little support that the proposal is temporarily in abeyance, and the Committee are seriously contemplating the desirability of returning the subscriptions they have already received. The amount that Edward accomplished for natural science was simply enormous, even if considered independently of the bright example of devotion that he has left for younger generations to imitate,—if they can. We cannot understand why a memorial of this kind should fall so flat, although we recognise fully that the tendency of the day is to sound the praises of technical education, and to sneer at such impractical things as mere sciences of observation. When the pendulum comes back in its swing, and the old-fashioned word "naturalist" comes once more into favour, we shall probably be heartily ashamed of the neglect with which the proposed memorial to Thomas Edward has been received.

Dr. Junker gave the Royal Geographical Society a field day of the first water on the 9th ult., when he told a crowded and admiring audience his story of that region of the "dark continent" which lies between the Upper Nile, the Congo, and Lake Chad. Rather, we ought to say, when he was expected to tell his story to the Society, for in truth the famous traveller said very little about his own work, and devoted himself mainly to the Mahdist rebellion, and his gallant friend Emin Pasha, to whose aid another renowned African traveller, Mr. H. M. Stanley, has recently started. Probably Dr. Junker felt his task too complicated for a single meeting of a society, and indeed it may well be supposed to be difficult to compress even the baldest account of six years' continuous exploration into a portion of an evening. Dr. Junker has shown, just as other travellers have, that Central Africa contains the most perfect system of inland water communication in existence, the term "network," as applied to its rivers, being literally, and not metaphorically true.

Mummy wheat is responsible for a great many troubles. It would be an interesting investigation to find out how many good men have gone astray, or have been led astray by the Arab who has learned to measure all things by their capacity for extracting backsheesh. Prof. Judd is the latest addition to this noble army of martyrs to a disposition over-endowed with faith. Botanists, who above all men are interested in the prolonged vitality of seeds, have over and over again protested against the loose way in which seeds, asserted to have been taken from some Egyptian mummy case, have been used to demonstrate the possibility of enormous vitality, and it is really hard for them to be told by Prof. Judd that "competent botanists have cited the case of the germination of seeds taken from ancient Egyptian tombs as authentic." Pray, Prof. Judd, do not be so chary in taking us into your confidence. Either let us know everything or nothing. Who are these certifiers to the character of mummy wheat? As, in our small way, earnest enquirers after scientific truth, pray let some light in upon the Egyptian darkness with which we are enshrouded.

General scientific education will, we hope, receive decided assistance from the recently printed report of the Select Committee on Endowed Schools. It is not yet twenty years since the Endowed Schools Commission cleared away the dust which for, in some cases, centuries had accumulated upon the work of the great public schools of England. Much valuable work there was shown to have been done, but as a whole it might be plainly stated to be altogether disproportionate to the amount at the disposal of the then existing governing bodies. In some cases all the worst vices of close corporations were seen to be reproduced. The broom the Commission then applied no doubt swept clean for the time, but there is no finality in educational systems. That the public has largely profited by the changes few will now deny; many will, however, no doubt be found to deny the value of the new changes proposed by the Select Committee, just as, at the time, blood ran pretty warmly over the recommendations of the old Commission. These briefly are to the effect that, amongst other needed reforms, these schools should be more largely used than heretofore for the promotion of scientific and technical education, and that local authorities should be authorised to employ local rates for founding or contributing to laboratories and workshops in such schools in order to promote practical scientific education. This latter recommendation, by the way, opens some dubious points. The actual value of a scientific education is probably on the whole realised in proportion to possession of it. Hence popular constituencies may not perhaps be the best custodians of the funds for the promotion at any rate of pure, as distinguished from technical, scientific training.

A Semi-aquatic Myxomycete.—The common habitats of the Myxomycetes or Slime-Fungi are damp surfaces such as rotten wood, earth, grass, moss, etc. A few species, belonging to a group allied to these, are, indeed, found in water. Such are most of the Monadineæ, many of the species of which are parasitic, as indicated by their names, *Vampyrella spirogyræ*, *Leptophrys vorax*, etc. To this group also belong the famous *Protomyxa aurantiaca*, so well known to all readers of Haeckel, and *Plasmodiophora brassicæ*, which is now considered (one may say demonstrated) to be the cause of clubbing in the roots of the cabbage tribe. But the Eumycetozoa, or true Myxomycetes, though their spores require to germinate in a small quantity of water, are rarely found therein when the plasmodium has attained any considerable size. It was, therefore, a pleasure to me when Mr. Bolton called my attention to the long plasmodial strings of a Myxomycete which he had found in the water of a little aquarium, containing organisms collected by him about ten days before in a gravel pit at Hill Oak, near Sutton Coldfield. These strings passed among the Spirogyra threads, and formed a network which here and there reached the sides of the vessel; some of them were nearly five inches in length. They were of a semi-opaque, sub-hyaline appearance, and if a part was carefully placed in a trough or cell, under the microscope, the motion of the protoplasm could be clearly perceived, exactly resembling that of an Amœba, except that it reversed its direction at tolerably regular intervals (about every half minute, according to my observations). A day or two afterwards some of the plasmodium was elevated into the air by the raising of the Spirogyra-mass to the surface, owing to the bubbles of oxygen entangled in it. At these points, and also where a small portion of the plasmodium had crawled up the surface of the glass vessel, sporangia were formed—white at first, but soon dusky brown, and finally bluish-grey; the last appearance arose from the formation of star-like crystals of carbonate of lime on the darker surface of the spore-mass. The species was seen on a microscopical examination of the capillitium to be *Physarum nutans*. W. B. Grove, B.A.

The Leicester Flora—note on the review of.—Mr. Bagnall points out an error in my article which appeared under *Œnanthe fluviatilis*; there is no *figure* of it in the Dillenian Ray, only a description. I had in my memory, which, alas, was defective, an old drawing of it. This, of course, does not alter the point of the sentence. Nyman was my authority for the statement that *Corydalis claviculata* was first described by Persoon in the Synopsis. It is true Persoon describes it there as a *Corydalis*, and gives no reference to De Candolle, who, however, had previously described it in the Flore Française. *Alyssum* *calycinum*, described in ed. ii. of the Spec. Plantarum by Linnæus, is referred by him to Jacq. Hort. Vind. in error, as it is not included in that early work of Jacquin's. In the name *Arenaria trinerva* a letter has dropped out; it should, of course, be *trinervia*. Withering points out that the Linnæan *Mentha piperita* was a form of *hirsuta*.

It appears necessary to make considerable changes in our nomenclature. For instance, the *Dentaria bulbifera* of Linnæus has been placed with the *Cardamines* by Syme, and in the Genera Plantarum the genus *Dentaria* is merged in that of *Cardamine*. It has been quoted in Lond. Cat. of Syme, but long ago Crantz called it *Cardamine bulbifera*. *Linaria purpurea*, which in the Flora is quoted of Linnæus, appears to have been first called a Linaria by Miller. In the Spec. Plant. it was given as an *Antirrhinum*. The varieties of *Montia fontana* were alluded to as *minor* and *major* in the Flor. Ped. by Allione, but more fully described under the same names by Roth in Tent. Germ. *Hypericum Elodes*, as pointed out long ago by my friend Mr. R. C. Pryor, should be quoted of Grufberg, as should *Cochlearia anglica*, and several other species at present attributed to Linnæus. G. C. DRUCE.

SHAMMING VEGETABLE.—An Indian mantis or praying insect, a little less wicked, though no less cruel than the spiders, deceives the flies who come to his arms under the false pretence of being a quiet leaf, upon which they may light in safety for rest and refreshment. Yet another abandoned member of the same family, relying boldly upon the resources of tropical nature, gets itself up as a complete orchid, the head and fangs being moulded in the exact image of the beautiful blossom, and the arms folding treacherously around the unhappy insect which ventures to seek for honey in its deceptive jaws. Happily, however, the tyrants and murderers do not always have things all their own way. Sometimes the inoffensive prey turn the tables upon their torturers with distinguished success. For example, Mr. Wallace noticed a kind of sand-wasp, in Borneo, much given to devouring crickets; but there was one species of cricket which exactly reproduced the features of the sand-wasps, and mixed among them on equal terms without fear of detection. Mr. Belt saw a green leaf-like locust in Nicaragua, overrun by foraging ants in search of meat for dinner, but remaining perfectly motionless all the time, and evidently mistaken by the hungry foragers for a real piece of the foliage it mimicked. So thoroughly did this innocent locust understand the necessity of remaining still, and pretending to be a leaf under all advances, that even when Mr. Belt took it up in his hands it never budged an inch, but strenuously preserved its rigid leaf-like attitude. As other insects "sham dead," this ingenious creature shammed vegetable.—"*Cornhill Magazine*" *for February*.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—BIOLOGICAL SECTION, April 29. Professor Hillhouse in the chair. Mr. Bagnall gave an introductory address on the "Classification of Mosses." He traced the history of the classification of mosses, with a fuller account of Schimper's system, which he considered the best to be adopted. He then described the two main series, namely, Acrocarpæ, with terminal fruit, and Pleurocarpæ, with lateral fruit, into which all the true mosses are divided; and then Bryineæ anomalæ, or the anomalous mosses, illustrating each with an extensive series of specimens and microscopic preparations.—

Microscopical Section, May 3. Professor Hillhouse in the chair. Specimens were exhibited of different kinds of rice from Eastern Bengal, by Mr. Walliker; and a series of specimens as exhibited by Mr. Bolton of photographs, taken at fifteen minutes' interval, under the microscope, of a Slime Fungus (*Physarum nutans*), showing its constantly changing network form. A paper was read by Mr. Bolton on the "Anatomy of Rotifers," illustrated by a series of living specimens in microscopes, and of coloured drawings of a rotifer (*Brachionus rubens*) that was selected as a typical specimen of this group of animalcula.—Biological Section, May 10. Mr. R. W. Chase in the chair. Mr. H. J. Carter gave a paper, read by Mr. W. R. Hughes, on the "Third Eye of *Anguis fragilis* (the common slow-worm)," that had been found to have a central median eye, imperfectly developed, in addition to the perfect pair of lateral eyes. This had a special interest in relation to a newly discovered three-eyed reptile, *Hatteria punctata*, in New Zealand, that was described by Mr. A. B. Badger in the "Midland Naturalist" for 1886, page 257; having a central median eye lying upon the surface of the brain but covered externally by the skin. This was of particular interest as suggesting in explanation of the doubtful pineal-gland or epiphysis found in a similar position upon the surface of the brain in vertebrates, a survival from some ancestral type common with the ascidians, which retain a single median eye. Mr. Hughes also gave an account of some unusually large specimens of sea-anemones (*Tealia crassicornis*) that he had recently seen in the Brighton Aquarium, several of which had seized and were in course of swallowing a herring as large as about seven inches in length. Mr. Burgess, of London, presented to the Society a type slide of 100 species of Foraminifera, from the Friendly Islands in the Pacific. Mr. Chase exhibited specimens of the Natterjack toad (*Bufo calamita*), from the Norfolk Broads. Mr. Bagnall exhibited *Tolypella glomerata*, one of the Characeæ, found at Whimpstone, near Stratford, and not previously recorded in the Midlands. Mr. Grove exhibited *Onygena apus*, from Newcastle-on-Tyne, a fungus found on dead hoofs of cows and other similar animal substances.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—March 21st. Mr. Dunn exhibited under the microscope a freshwater worm, *Nephelis*; Mr. Hawkes, specimens of *Vaucheria racemosa* and *V. sessilis*, and explained their modes of reproduction; Mr. H. Insley, a section of a Lancashire coal-ball through rootlets of Stigmaria. — March 28th. Mr. J. Collins read a paper on "Low Forms of Vegetable Life." The writer said the morphology and physiology of the lower classes of vegetable life were but little understood, even by many advanced students of botany, and until very recently they had not been popular branches of the vegetable kingdom, though this fact alone was sufficient to commend them to practical naturalists. The division between the algæ and fungi was described as an artificial one. This interesting paper was illustrated by diagrams, and slides under the microscopes. —April 4th. Mr. H. Insley showed part of the spinal column of an Ichthyosaurus, from the Lias; Mr. Hopkins, specimens of *Vertigo edentula*, from Solihull; Mr. J. W. Neville, a Gorgonia, from Australia, and spicules of the same under the microscope.—April 18th. Mr. H. Insley exhibited some sketches of the auditory organs of insects; Mr. A. T. Evans, pebbles from the Drift containing specimens of *Orthis elegantula*, Modiolopsis and other fossils; Mr. J. Collins (under the microscope), *Draparnaldia glomerata*; Mr. J. W. Neville, palate of *Testacella haliotidea.* Mr. J. Madison then read a paper on "A Visit to Loch Skein." The writer described the journey as a conchological one. The route taken was through Moffat Dale, where a waterfall, "The Grey Mare's Tail," was visited. When Loch Skein was reached, though the 13th of June, the mountains had twelve inches of snow on their summits. The Loch was worked as one of the two recorded habitats of *Limnæa peregra* var. *Burnetti*, the other one being in Carmarthenshire. Many specimens were taken, though the mature ones were much eroded. The writer described a ramble by St. Mary's Loch, and through Selkirk and Melrose to Edinburgh, from whence the return was made. At the close of the paper the collection of shells was exhibited.—April 25th. An evening devoted mainly to conchology. Mr. C. P. Neville exhibited a series of specimens of Conus from the Magellan Straits; Mr. P. T. Deakin, a collection of land shells made in Somerset and Dorsetshire; Mr. J. Madison, a large collection of *Helix aspersa*, showing 180 variations from the type specimen; Mr. Moore, a collection, chiefly of the neighbourhood; Mr. A. T. Evans, *Terebratula caput-serpentis;* Mr. H. Insley, fossil shells from the Chalk and Greensand; Mr. H. Hawkes, a specimen of *Empetrum nigrum*, and (under the microscope) capsules of Jungermannia, showing elaters scattering gemmæ and spores.—May 2nd. Mr. J. Moore showed specimens of the Black Ant, *Formica nigra*, and gizzard of the same under the microscope; Mr. F. Shrive, living specimens of the common ring snake; Mr. J. W. Neville, a slide of selected foraminifera from sponge sand; Mr. H. Hawkes, twin female flowers of *Taxus baccata*.—May 9th. Mr. Mulliss exhibited a fœtus two months old; Mr. A. T. Evans, part of a trilobite in a quartzite pebble from the Drift. A paper written by Mr. Thoms, F.R.M.S., on "The Origin of Leaven," was then read by Mr. Hutchinson. The writer took exception to the accepted views of M. Pasteur and others that life only proceeded from life germs in the atmosphere, quoting the fact of his having found bacilli, etc., in cells having no apparent inlet through which germs from the atmosphere could be conveyed. The writer concluded that the organisms in such cells were the result of disintegrated cell contents becoming functional.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY. —SECTION D, ZOOLOGY AND BOTANY. Chairman, F. T. Mott, F.R.G.S.— Evening meeting, Wednesday, April 20th. Attendance nine (one lady). The chairman thanked the members for their confidence and assistance during his three years of office. He thought it was undesirable to make the post a permanent one; that a change of leadership would tend to freshness and vigour, and that all the active members of the Section should occupy the chair in turn; he wished, therefore, to resign the post, and moved that Dr. Tomkins, Officer of Health for the Borough, be elected chairman for the ensuing year from June next, and that Dr. C. W. Cooper be re-elected hon. secretary. The motion was carried unanimously. The chairman reported that at the Field Day Excursion on the 9th, the first of the season, six members visited the Old Ansty Lane. The day was cold and dull, but they collected nine species of mosses, among them being *Brachythecium glareosum*, new to the county; two species of Hepaticæ, one being *Lophocolea heterophylla* in full fruit; and five species of land shells, among them a single specimen of the rather rare *Bulimus obscurus*, and a whole community of the pretty *Helix rotundata* under the bark of an old stump. The following objects were exhibited, viz:—By Mr. E. F. Cooper, F.L.S., a flowering branch of a *Eucalyptus*, probably *globulus*, received with other cut flowers from the Riviera. By Rev. T. A. Preston, M.A., specimens in spirit of the floating sea-weed, *Sargassum* *bacciferum*, and of a number of small marine animals taken among the living weed in the Sargasso Sea, including *Medusæ*, several small fish and crustaceans, the trigger fish, a small cephalopod, &c.; also a specimen of the curious fungus, *Geaster fornicatus*, the "vaulted earth-star." By Mr. W. A. Vice, specimens of three interesting fungi collected at Blaby, *Hypoxylon concentricum*, a solid black mass two inches long, new to the county; *Nectria pulicaris*, and *Podisoma Sabinæ*, neither of them recorded in the Leicester district. The chairman introduced a discussion on cleistogamous flowers, pointing out that whereas Darwin had shown the importance of cross fertilisation and the many remarkable contrivances among plants for securing it, it was found that a considerable number of plants bore, in addition to their ordinary flowers with open coloured corolla, other flowers generally without corolla and never opening at all, which seemed purposely formed for securing self-fertilisation, and which generally perfected seed while many of the open flowers were barren. These closed and inconspicuous flowers were called cleistogamous; what was their real purpose? Mr. E. F. Cooper showed fresh and dried specimens of *Viola odorata*, *V. hirta* and *V. Riviniana*, bearing flowers of both kinds. Darwin suggests that the closed flowers are degraded organs for securing ripe seed at the least possible cost of energy to the plant. The chairman suggested that they might be survivals of an early form of the reproductive organs before the corolla-bearing epoch was reached.—Evening Meeting, Wednesday, May 18. Attendance 14 (three ladies). Chairman, F. T. Mott, F.R.G.S. The chairman reported that the field-day excursion last week was attended by six members, who visited the gardens at Belvoir Castle, under the guidance of Mr. Ingram, and were delighted with the beauty of the Spring flowers. Camellias and the Himalayan rhododendrons, which have remained in the open air without protection for many years, were in full bloom, and a number of rare and beautiful hardy herbaceous plants were seen, with a fine collection of varieties of *Narcissus*. The following objects were exhibited, viz., by Mr. W. A. Vice, specimens of ripe loquats (*Eriobotrya Japonica*), sold in the streets of London, and several fungi; Rev. T. A. Preston, a beautiful microscopic slide of the *Amphioxus*, with several other examples of it in spirits, and a specimen of the curious fungus *Cordyceps entomorrhiza*, growing on a caterpillar from Norfolk; by the chairman, Dr. Cooke's work on the British Myxomycetes, translated from the Polish. Mr. Thos. Carter, LL.B., introduced a discussion on "A Botanical Garden for Leicester." He said that in France there was a system of such gardens in the principal provincial towns, all in connection with the central gardens at Paris, a system which dated from the great revolution; that while travelling in France he had found these gardens very useful, and that such a garden in Leicester would greatly facilitate the study of botany. The discussion was interesting and lively. The chairman produced a rough design which he had sketched for a very complete botanical garden of ten acres, in which visitors would pass successively through arctic, temperate, sub-tropical, and tropical floras, and in which there would be special departments also for the local flora, medical plants, hardy fruits and vegetables, agricultural plants, with experimental grounds, and a type series illustrating the botanical orders. It was finally determined that Mr. Byrne, of the Abbey Park, should be consulted as to the possibility of some small beginning being made there, and that, if it seemed possible, the Park Committee should be approached on the subject. Mr. J. H. Garnar read a short paper on "the Entomostraca," describing some personal observations confirming the published views of Dr. Baird, and illustrated by living specimens exhibited under the microscope as well as by a number of mounted slides.

RAGNAROK.*

BY G. DEANE, D.SC.

Whether this book should be regarded as a *jeu d'esprit*, or subjected to calm and judicial criticism, is a matter not easy to decide. To those unacquainted with the course of patient and careful investigation by which the present knowledge on the subjects here treated of has been gained, some of the arguments adduced will appear to possess a certain amount of plausibility, especially to readers predisposed to accept with slight or no proof the catastrophic and marvellous. Also the general character of the book makes it interesting reading. But, as a serious treatment of the subjects dealt with, it will certainly fail to commend itself to the judgment of experts either in Physical Science, Mythology, or Biblical Exegesis.

The author advances a novel and ingenious but unsatisfactory theory as to the origin of the so-called Glacial or Drift deposits of Europe, Africa, and America. After examining the character of the Drift, and the various theories now held by leading geologists as being concerned in its production, he makes the astounding suggestion that all these deposits have been caused by a collision with a comet; and, inasmuch as they are said to occur only on the hemisphere of the earth which includes Europe, Africa, and Eastern America, the presumption is that the comet in whirling at enormous velocity round the sun lashed that hemisphere and that only with its tail. The result was an immense development of heat which vaporized the oceans, destroyed all life except a few men who obtained safety in caverns, melted rocks, vaporized metals, and burnt and hardened the underlying Till or Lowest Boulder Clay, whilst the immense impact of dust, sand, pebbles, and boulders forming the comet's tail furrowed and scratched the earth's surface, produced chasms and crumpling in the rocks, and caused the fiords of the sea coast. After this delightful catastrophe condensation occurred accompanied by extreme cold, and immense torrents of primeval rain which partially re-arranged the boulders, stones, and clay, left by the comet's tail. After this the few saved men came forth from their caverns to inhabit the mythical island of Atlantis in the centre of the Atlantic Ocean; and from this point they radiated again to overspread

* Ragnarok: the Age of Fire and Gravel. By Ignatius Donnelly, Author of "Atlantis: the Antediluvian World." London: Sampson Low and Co.

the earth. For a theory like this we must go back to the mythical age of Geology, and even the explosive caverns of De Luc are less astounding.

The book then examines the nature and growth of myths and legends, gives a long and interesting account of the legends of various nations, and maintains that these are not only explicable by but actually point to the theory of a comet collision. In this part of the book we find the origin of its curious title. Ragnarok, meaning either "the darkness of the gods" or "the rain of dust and ashes," is the word used in some Scandinavian legends which record the coming of the comet. Then follow discursive discussions on the Book of Job and the Genesis narratives, wherein the comet is identified with the Satan of the former and the Serpent of the latter; and in treating the Arabian myths two lovely pictorial illustrations of the gentleman are given. The author continues with an account of Biela's comet, which he suggests was the cause of the great American fires in 1871; maintains that the earth has been struck by comets many times, thus causing the Appalachian Range of America, the Cambrian and Old Red conglomerates, the Lower Silurian boulders of Scotland, and sundry other specified strata; and concludes by a highly religious epilogue on "The After World," which he especially commends to the consideration of the "Dives" of the present.

It is impossible, within the limits of a brief review, to discuss the whole of these statements and reasonings, but the more important may with advantage be noted. The quotations from the numerous authors referred to are as jumbled and intermixed, without any regard to locality or time, as the Drift deposits themselves, and this fact does not tend to clearness of discussion. The authors quoted would, in some cases, certainly be surprised at the inferences drawn, or rather suggested, from their words. Concerning the four theories by which it has been attempted to explain the Drift, and which this book rejects, the first, viz., the Diluvial, may be put out of the question. There remain the action of icebergs, of glaciers, and of a continental ice sheet. Now each of these is undoubtedly a *vera causa* in actual operation on the earth's surface at present, producing phenomena and results analogous to those found in the Drift deposits. There now is a continental ice sheet in Greenland and in the Antarctic regions, from which icebergs invade the northern and southern oceans. Most high mountains above the snow line are snow capped, and their glaciers descend into the valleys, carrying with them the materials of their moraines. To these three true causes might be added another in the known phenomena of shore and river ice. These four causes are undoubtedly at work now in different districts of the earth's surface. How they were combined, and in what manner they were enlarged and intensified so as to produce the glacial deposits, is a matter for fair discussion and fuller research.

But can the same in any sense whatever be said of a comet? In other words, can a comet be said to be a *vera causa* at all? The physics of the cometary system have become much better known in late years than formerly; but still much remains to be known. What is known, however, utterly negatives the idea that one of these erratic visitors caused the Drift. This book speaks of a comet "many times larger than the mass of the earth" (p. 264); and again (p. 399) of "the attractive power of the comet great enough to hold its gigantic mass* in place through the long reaches of the fields of space." Whereas it is perfectly well known that the mass of existing and recorded comets must be very small compared with that of other bodies in the Solar system. Otherwise the perturbations caused in planetary motions must necessarily have been observed by astronomers. Indeed, our author quotes from the "Edinburgh Review" that "In the years 1767 and 1779 Lexell's comet passed through the midst of Jupiter's satellites and became entangled temporarily among them. But not one of the satellites altered its movements to the extent of a hair's breadth, or the tenth of an instant." This shows that the mass of this particular comet must have been very small. Moreover, the extreme tenuity of cometary matter is shown by other things; the writer of these lines himself saw the star Arcturus shining brilliantly through Donati's comet in 1858; and it is a well-known fact that a star of the fifth magnitude was clearly seen, with no abatement of its light, through the centre of the nucleus of the comet discovered by Miss Mitchell in 1847.

Nor, indeed, does the now commonly received hypothesis that some comets are attended in their orbits by meteoric masses, which occasion displays of shooting stars, in any degree support the idea that a comet caused the glacial deposits. Meteors and aerolites are very different things from boulders.

It may of course be urged that known comets of modern days can be no measure of the gigantic results which accrued from them ages ago. But, surely, if they were of such gigantic mass as Ragnarok represents, they would have been

* Is it possible that the author here has confounded the word 'mass' with 'magnitude'? Magnitude may be immense when mass is small.

reduced to orderly conduct by mutual attractions with other bodies of the Solar system, or dispatched again into space.

For these and other reasons we decline to receive, as a *vera causa* of the Drift deposits, the impact of a comet. Whilst at least four true causes are known to be at work on the earth's surface now, whose combination can explain the facts, there is no need to journey to a hypothetical comet for an explanation; nor is it probable that such a comet will journey to us, and if it should the results would be anything but glacial.

A word or two must be said concerning the origin of the boulders and erratic blocks, and also concerning the absence of evidence of life from the deposits. As to the former it is well known that in our own Midland district the boulders are identical in composition and appearance with local rocks, and also with rocks occurring *in situ* in Wales, the Lake district, and Scotland. The phenomena are similar in character in other districts. There is no need to go to a comet to account for these. Concerning the absence of evidence of life the author appears to have somewhat misunderstood the statements he quotes from sundry geologists. These refer simply and solely to contemporary life, not to fossil evidence of life from other formations. In our own district the boulders and Drift pebbles contain abundance of well-known fossils derived from Palæozoic and other rocks, as the collection in the Midland Institute, and that exhibited in Bingley Hall last September, clearly demonstrate. The material of the Drift came from previous formations. There is no need to go to a comet when such rocks occur within 100 miles, and also at no great distance beneath our feet.

Passing now for a moment to the Biblical Exegesis, though that scarcely belongs to a scientific journal, it is even more startling than the science. The writers of the books of Job and Genesis would certainly be appalled if they saw the explanations of Ragnarok. Its author has re-arranged, excised, and explained in such a way as to produce a tessellated mosaic of the Mosaic narrative, at which even the most advanced of modern critics would stare in amazement.

Now, finally, for one or two brief illustrations of quaint sayings and reasonings. Page 405 states "In the age of man's declension he moved eastward. In the age of his redemption he moves westward." If this statement be true it is good for America but bad for Britain. On page 366 is found "The negro race, it seems probable, may have separated from our own stock in pre-glacial times, and survived, in fragments, somewhere in the land of torrid heats, probably in some region on which the Drift did not fall. We are told by Ovid that it was the tremendous heat of the comet age that baked the negro black; in this Ovid doubtless spoke the opinion of antiquity. Whether or not that period of almost insufferable temperature produced any effect upon the colour of the race I shall not undertake to say, nor shall I dare to assert that the white race was bleached to its present complexion by the long absence of the sun during the Age of Darkness."

In treating of Biela's comet it is written :—"In the year 1871, on Sunday, the 8th of October, at half-past nine in the evening, events occurred which attracted the attention of the whole world, which caused the death of hundreds of human beings, and the destruction of millions of property, and which involved three different States of the Union in the wildest alarm and terror." Then follows a detailed account of the immense fires which broke out at the time stated, "*at apparently the same moment*, at points hundreds of miles apart, in three different States, Wisconsin, Michigan, and Illinois." And these the author connects directly with the impact of Biela's comet, which is stated to have occurred on the 27th of November, 1872. This is going rather too far. How could a comet's impact, on the 27th of November, 1872, cause fires, at Chicago and other places, on the 8th of October, 1871? Moreover, Biela's comet, or its tail, did strike the earth on 27th November, 1872, and was seen from Madras, some days afterwards, on two consecutive mornings—"circular, bright, with a decided nucleus but no tail, and about forty-five seconds in diameter" (see Edin. Rev., Oct. 1874, p. 414). The presumption clearly is that the tail was partially burnt up in the earth's atmosphere, causing the magnificent meteoric shower of that date.*

Surely the book must be a *jeu d'esprit* after all. It is amusing reading, but as a serious contribution to the literature of the subject is highly unsatisfactory.

HISTORY OF THE COUNTY BOTANY OF WORCESTER.

BY WM. MATHEWS, M.A.

(*Continued from page 156.*)

SECOND PERIOD, 1751 TO 1800.

The third volume of the second edition of Withering was published in two parts. Part I., containing additions to the first two volumes, errata, index, and other matter, is undated.

* The reader will find the full story of Biela's comet narrated in "Nature," vol. xxxiii, pp. 392, 418.

Part II., containing the Cryptogams, with title page to the whole volume, bears date 1792. The only references in Vol. 3, germane to this history, are the following :—

Stokes in Withering. Edit. 2, Vol. 3, 1792.

Trifolium flexuosum, Jacq., p. cxxvi. Worcestershire. St. (*T. medium, L.*)

Ophrys ovata, cxxvii. Hurcot Wood. St. (*Listera ovata, R. Br.*)

Ophioglossum vulgatum, p. 45. Broadmoore, near Birmingham. With.

* **Osmunda Lunaria**, 46. Coal Pit Banks, near Stourbridge. Mr. Waldron Hill. *Whether in Worcester or Stafford is not stated.*

Polypodium vulgare, 55. β. Wings doubly serrated. Worcestershire. St.

Adding the 4 new records in this list to the 105 in the previous one, it appears that Dr. Stokes contributed 109 species to the Worcester Census, chiefly on the authority of Mr. Ballard, besides publishing new localities for plants previously noted. If he had also recorded the commoner species he would have laid the foundation for a complete Flora of the County.

I find that the Snowdrop, Galanthus nivalis, was first recorded by Withering in the first edition of his Bot. Arr., 1776, appendix, p. 783 *(bis)*, as "growing plentifully at the foot of Malvern Hills, Worcestershire," on the authority, as we learn from Stokes, of Mr. Ballard. My friend Mr. Towndrow informs me that the locality is in the County of Hereford, and that the plant still grows there.

The names of the localities in Dr. Stokes's list differ somewhat from those by which the same places are now known. Robinson's End is Robert's End, and the cluster of houses there Robert's End Street. Clarkton Leap is Clerkenleap, near Kempsey. The Ridd should be the Rhydd, and the Blankets the Blanquettes.

In the year 1789 a new edition of Camden's Britannia, by Richard Gough, was published, in 3 vols. fol. This work is cited by Dr. Trimen, in the article previously referred to, among "the Botanical Bibliography of the British Counties." The Editor states in the preface, p. v., that the want of "*a formal catalogue of plants peculiar to each County*" . . . . "*has, I trust, been in some measure supplied by the help of some young friends who have exerted their utmost diligence in collecting the plants peculiar to each County from books and from the researches of themselves and other Botanists, who have multiplied since Ray in the same proportion that science has improved.*" The curious inquirer, who turns to the Worcester list, in

Vol. II., p. 374, will be surprised to find that it is simply an appropriation, without acknowledgment, of the list published by Dr. Nash, re-arranged in alphabetical order, with one of the species omitted, probably by accident, and that Stokes's work is ignored. We may, therefore, dismiss Mr. Richard Gough and his diligent young friends from further notice in these pages.

The third edition of the "*Arrangement of British plants*" was published in 1796, three years before the death of the Author. It appears to have been edited by Withering himself; at any rate, I find no trace of the hand of Dr. Stokes. It contains many new County records, and names of new correspondents, among whom may be mentioned the Rev. Mr. Baker, of Stouts Hill, Gloucestershire; Miss Read, probably of Bromsgrove; and Mr. Wm. Pitt, the author of a series of Reports on the Agriculture of the English Counties. The following is a list of the new records contained in these volumes, and of new localities of species previously recorded, where they are of sufficient interest to republish :—

Withering, 3rd Edition, 1796.

* **Hypericum Androsæmum**, p. 663. In a deep holloway in a marly soil between Worcester and Tewkesbury.

H. dubium, 665. Discovered first as an English plant by Dr. Seward, of Worcester, growing plentifully about Sapey in that county.

Geranium phæum, 605. Near Cradley, Worcestershire.

N.B.—The Worcestershire Cradley is between Halesowen and Stourbridge and must not be confounded with the Herefordshire Cradley, near Malvern.

Genista anglica, 625. Broadmoore, near Birmingham.

* **Lathyrus Nissolia**, 632. Hadsor Wood, near Droitwich. Mr. Baker.

* **Rosa spinosissima**, 465. Frequent in the sandy Country about Bewdley.

Galium Cruciata, 187. Plentiful from Newcastle to within a few miles of Worcester, but further south it is scarce. Mr. Baker.

Onopordum Acanthium, 704. Road from Worcester to Droitwich near Henlip. Mr. Baker. "*Henlip*" *should be Hindlip.*

* **Campanula patula**, 242. Near Hagley on the Kidderminster Road, plentiful.

C. Rapunculus, 242. Hindlip, Worcester.

C. latifolia, 243. On the road from Halesowen Abbey to Birmingham, a mile from the former, on a shivery sand rock.

* **Vaccinium Myrtillus**, 370. Lightwoods, near Birmingham.

Veronica scutellata, 16. Broadmoor, near Halesowen.

Euphrasia Odontites, 543. Var. 2. Flowers white. Sent to me by Mr. Bourne, who gathered it on Northington Farm, Grimley, near Worcester.

Melampyrum pratense, 545. In the woods near the road from Birmingham to Halesowen.

Nepeta Cataria, 519. Dudley Castle.

* **Melissa Calamintha**, 538. Dudley Castle.

* **Polygonum pallidum**, 381. Var. 3. Stems spotted with red. In a ditch on Stourbridge Common. St.

This is the P. pensylvanicum, var. petechiale, of Stokes. In later editions of Withering it appears as a variety of P. lapathifolium. It is almost certainly P. maculatum, Dyer.

Ulmus campestris, 278. Plentiful in Worcestershire.

Carex ampullacea, 110. Mill below Droitwich. Mr. Baker.

Poa maritima, 147. Near the Canal from Droitwich to the Severn. Mr. Baker.

This is the first record of a maritime plant in the saline waters of Droitwich.

Festuca duriuscula, 153. Walls of Dudley Castle.

Asplenium Ruta-muraria, 769. Walls at Bewdley.

Polypodium Oreopteris, 775. In a wood at Old Foot's Well near Bromsgrove. Miss Read.

"Old Foots" Well is doubtless a misnomer for Offad's Well, between "the Valley" and Dodford.

P. aculeatum, 777. In a ditch in a meadow in the Valley near Bromsgrove. Miss Read.

P. fragile, 779. Road from Bourn Heath to Worms Ash near Bromsgrove, Miss Read.

The above list yields 19 new County records in addition to those previously published by Dr. Stokes.

I have failed to identify the locality called Broadmoor. As it is described by Stokes as "3 miles S.W. of Birmingham," and by Withering as "near Halesowen," I conclude it to be in the County of Worcester.

In 1799, Nash published a supplement to his History. This contains, at p. 96, an additional list, as to which Nash states that "*The following plants were observed in Worcestershire by my ingenious friend Dr. Sheward, whose untimely death was a great loss to the Infirmary, to the science of medicine, and to the public in general.*" Forty-seven species are enumerated in the list. Of these, two are Fungi—the Morell and the Truffle; seventeen are new or independent records of plants previously noted by Stokes. The remaining twenty-eight are as follows:—

Sheward in Nash's Supplement, 1799.

Dianthus deltoides. Blackstone Rock, near Bewdley.

* **Hypericum dubium.** First found in Worcestershire about Sapey; found since in many other places, as Witley and Martley, growing plentifully by the road side; often mixed with H. perforatum.

* **Geranium phæum.** Well Meadow, below Abberley Village.

Ornithopus perpusillus. Abberley Hill.

Astragalus glycyphyllus. On a marle bank near Gregory's Mill.

Geum rivale. Near a flight of steps leading from the Hope Farm to Sapey Church.

Epilobium tetragonum. Foot of Malvern Hill.

Chrysosplenium oppositifolium. With **C. alternifolium.** Near Sapey Brook, in many places.

Sium angustifolium. Ditches near Perry Wood.

Sison Segetum. On a marle bank near Gregory's Mill.

* **Apium graveolens.** Brook side, Salwarpe.

* **Adoxa Moschatellina.** Shady places, Sapey Brook, abundantly.

Asperula cynanchica. Broadway Hill.

Carduus acaulis. Dry Pastures, Sapey.

Erigeron acre. Tops of Walls about the Cathedral.

* **Campanula latifolia.** Hedges below Malvern Hill.

Pyrola rotundifolia. In a wood on the Witley side of Abberley Hill.

Vinca minor. Side of the road to Martley opposite Kemsey Mill.

Vinca major. Roadside, Little Witley and Clifton Hill.

Gentiana campestris. Bewdley Forest between Furniss Mill and the Eagle's Nest Inn.

It is doubtful if this is a Worcester record. Furnace Mill is in Salop.

Verbascum Blattaria. Roadside, Holt.

* **V. minus, flore luteo, foliis acutis.** At the end of the Green Lane in the Parish of Claines. (*Possibly V. virgatum.*)

Mentha rotundifolia. Several places near Sapey Brook.

Triglochin palustre. Boggy Meadows near Sapey Brook.

Convallaria majalis. Shrawley Wood.

Ophrys spiralis. Dry Pastures, Sapey.

Serapias ensifolia. In a wood on the Witley side of Abberley Hill.

* **Scirpus culmo tereti, nudo, capitulo laterali, conglobato.** Single-headed club rush. Found at Throckmorton in the Parish of Fladbury. (*S. romanus.*)

Deducting 7 plants previously noted, giving Dr. Sheward credit for Gentiana campestris and Verbascum Blattaria, his list yields 21 new County records, or, if we include Hypericum perforatum, 22. The following caution of Dr. Stokes (Bot. Arr., 2nd Edit., p. 229), should be borne in mind respecting Verbascum Blattaria :—"*My specimens from gardens, and having never seen it growing wild, I have been sometimes induced to suspect my Virgatum to have been taken for the true V. Blattaria.*" Mr. Towndrow, however, assures me that he has seen V. Blattaria at West Malvern, and, he believes, also at Madresfield, so that there is no reason to doubt its being a Worcester plant. The Scirpus is obviously S. romanus and has the appearance of an independent record, 21 years after its first publication by Hudson in the "*Flora Anglica.*"

The records to the end of the 18th century may be summed up as under:—

First Period, to 1750		11
Second Period, 1751 to 1800—		
Hudson, *Flora Anglica*, 2*nd Ed.*, 1778 ...	1	
*Nash, *Coll. Hist. Worc.*, 1781	39	
Stokes, *With. Bot. Arr.*, 2*nd Edition* ... 1787—1792 ...	109	
Withering, *Bot. Arr.*, 3*rd Ed.*, 1796 ...	19	
Sheward, *Nash, Suppt.*, 1799	22	
	——	190
		201

The close of the 18th century is notable for the appearance, in 1790, of the first of the 36 volumes of the celebrated "*English Botany*," the figures by James Sowerby, the descriptions by Sir J. E. Smith. We learn from the latter that Dr. Stokes was one of his most valued contributors. He writes of him (Vol. I., No. 19) "*whose accuracy and extensive information none can doubt.*"

It will be interesting to mention, in this place, that in the description opposite to the plate of Verbascum virgatum, No. 550, Vol. 8, 1799, Sir James Smith writes as follows:— "*Dr. Stokes first clearly ascertained this species.*" "*Our worthy friend, the Rev. Mr. Baker, took this individual plant, when a seedling, from one of the spots near Worcester mentioned by Withering, and it flowered in his garden. He informs us this Mullein was first observed growing plentifully in a field near Wrexham, by Mrs. Nash, who planted it in her garden at Bevere, from whence probably its seeds got to the neighbouring Turnpike road to Ombersley, and from thence to the lane leading to Gregory's Mill.*" The plant now grows in several spots in the north of the County, where it is difficult to imagine that it can have spread from Bevere.

In Vol. 23, 1806, No. 1,612, Smith writes, under Scirpus Holoschœnus, "*The last-named Botanist (Hudson) mentions the Scirpus romanus, which I am convinced is a small variety of this, as growing in marshes near Throgmorton, Worcestershire.*"

* I have allowed the Snowdrop to remain in Nash's record. But if his locality was in Hereford the first record of this species as a Worcester plant must be transferred from Nash to Stokes.

(To be continued.)

THE MIDDLE LIAS OF NORTHAMPTONSHIRE.

BY BEEBY THOMPSON, F.G.S., F.C.S.

(Continued from page 113.)

II.—Would the Water go into the Middle Lias Beds?

At the commencement of the discussion which this scheme for water supply provoked, at Northampton, I was asked for proofs that the surface water would go into the beds of the Middle Lias, from which the town supply was then obtained. It was asserted that the Marlstone Rock-bed yielded no water at the Spinney Well near Northampton because of the closeness of the rock, and that the beds below were all clays and did not carry water, and it was suggested that like conditions might exist in those parts where I proposed to place feeding wells. I had no personal knowledge of the condition of the Middle Lias beds at the Spinney Well, and the descriptions that have appeared of the Spinney Well in my own papers and those of Mr. Eunson were given by the sinkers of the well, and so are not very exact in the description of the beds. Such being the case, I think I may be permitted to doubt the adequacy of the reason assigned for getting no water, and to assign another, as I do later on. The fact that no water was obtained, however, induced me to consider the matter much more fully than I should otherwise have thought necessary, although this stands out as an isolated instance of finding the Marlstone of the county without water, amongst hundreds of others in which water has been found. In Part I. numerous sections are described, from which a good idea of the character of the Middle Lias beds in Northamptonshire can be obtained, and it will have been noticed that there are two sets of springs—the first being thrown out near the top, by the clays just below the Rock-bed; the second near the base of the Middle Lias.

There is no one place where the whole of the Middle Lias beds can be seen, but on the whole, perhaps the best section is at Staverton, thirteen miles west of Northampton (see Part I., p. 211, Vol. VIII.), and anyone visiting this place will, I am sure, be quite convinced that there are two sets of springs in the Middle Lias of this part of the county, and that the sandy micaceous beds of the "*Margaritatus*" *Zone* are pervious to water.

It is several years since I first suggested that these porous beds of the "*Margaritatus*" *Zone* might be used as reservoirs for surplus water. I believe they now act in much the same way as the chalk, *i.e.*, absorb large quantities of water and slowly deliver it to the water-bearing bed at their base, and thus tend to equalise the flow throughout the year. If the lower water-bearing bed were more frequently used, and the water pumped from it at points situated some distance from its outcrop, there is little doubt that the sandy beds of the "*Margaritatus*" *Zone* would absorb and allow to pass through them much more water than they do now.

At only one place—Dodford—have I seen water actually flow from these soft beds, and there it might have been from a fissure communicating with the lower spring, as it was most certainly within a few feet of the latter. The general dryness of Middle Lias lands, of these beds as seen in a section, and the readiness with which a specimen will absorb water, combined with the fact that nearly all the fossils found in them are casts only, show that water has a fairly ready passage through them. Now, although the success of the scheme for water supply that I am discussing does not depend upon these beds retaining the characters they have in the western parts of the county as far as Northampton, nor, indeed, upon their existence there, still a demonstration of their presence, and of the lower spring, so far eastward, would favour any project for the utilisation of the Middle Lias as a reservoir for surplus water.

On the first occasion when this scheme was presented to the Water Committee of the Town Council of Northampton, I spoke of the sandy micaceous clays and the second spring as existing at Northampton, but the existence of either was denied, I presume from a consideration of the results obtained at the Spinney Well. Considering that I put a different interpretation on the results of this boring, I also retained my opinion on the two points referred to above.

With regard to the porous beds of the "*Margaritatus*" *Zone* I may have been partly wrong; that is, they may be less sandy, and consequently less porous under Northampton than further westward, as they are thinner, but this is not certain; what little evidence there is will be given presently. So far as these beds can be traced by superficial sections, they vary very little. At Staverton, Badby, Newnham, and on the north side of the great Nen fault, near to Weedon (new railway cutting), they have nearly the same characters. The evidence as to the lower spring has accumulated until it is quite conclusive. It must be borne in mind, that in making wells in the Middle Lias, water is, practically, always found in the Rock-bed, and until recent years the water so found would generally rise to a considerable height in the wells, so that further sinking would be somewhat difficult and quite unnecessary; hence the second spring was never found.

In the summer of 1884, this lower spring was tapped within about four miles of Northampton under the following circumstances. In the village of Milton there are some fifteen or twenty wells in the Middle Lias, from which plenty of water was obtained until the last few years. One of these wells, probably a hundred years old, is in the house used as an inn—The Greyhound—and occupied by Mr. East, who is also a brewer. The supply of water being inadequate, the well was opened, and it was found that the rock was only just broken into, as though an inrush of water had stopped further operations. To get more water it was necessary to deepen this well or dig another outside the house; the latter plan being decided upon, it was commenced, and water had been found before I heard of the work. The water came chiefly from the lower part of the rock, and did not quite cover the bed. Mr. East asked my advice as to going deeper, in order to make a reservoir for storing the water, which did not flow in as fast as they at times wanted to pump it. I ventured to recommend him to go deeper with the object of tapping the lower spring, which, if present, would certainly be met with within 40 feet. It was decided to deepen the well, and when they had got down 10 feet lower, a hard nodular bed was met with; this was only just broken into when a jet of water burst out to a height of a yard, and the influx of water was sufficient to stop further sinking. The section of this well has been already given (Part I., p. 75, Vol. IX.) After stopping the Rock-bed supply and bricking the well down to the lower water-bearing rock, the water rose and stood in the well 10 feet; that is, to almost the same level as did the Rock-bed supply previously, although its source was 10 feet lower. It shows no tendency to sink lower, and by their present pumping power (900 gallons per hour) they can only reduce the water level 4 feet. Thus it will be seen a difference of head of 4 feet between the water level in the well and the adjacent strata gives a flow of about 21,600 gallons per day.

The discovery of this second spring in the Middle Lias so near to Northampton I considered rather important, because from its position, almost south of Northampton, it furnished almost conclusive evidence that the same bed existed at Northampton itself, and therefore made it more probable that the sandy micaceous beds also existed, as one or more of them certainly did at Milton. Here, however, is the little piece of adverse evidence referred to a page or two back. The micaceous clay—see Section, p. 75, Vol IX.—out of the well seemed about as I expected to find it, but quite dry, whereas the bed just below yielded water under considerable pressure. From the condition of the fossils, too, I do not think much water had passed through this bed.

About this time attention was directed by the opponents of this scheme to a fresh instance of the Marlstone being found without water. It was a well sunk at Messrs. P. Phipps and Co.'s Brewery. On investigation I was surprised to find that a large amount of water was being obtained from the well; it issued from cracks in the rock along two headings, and the amount of water was increasing rather than diminishing, owing probably to the development of more definite channels. I was still more surprised to find that the rock was not the *Rock-bed*, but the lower water-bearing bed. The evidence on this latter point was quite definite, the common Rock-bed fossils were entirely absent, and those characteristic of lower beds present; furthermore, Mr. T. Phipps informed me that the water was quite different to that supplied to them by the town waterworks.

This same spring was also met with at Gayton (see p. 74, Vol. IX.)

It seems, therefore, practically certain that the lower spring might have been found at the Billing Road Well had it been sought for, and from its position, on the northern side of the Nen fault, it might be expected to yield a supply of water greater than that of any of the other places where it had been tapped in the neighbourhood. The expense connected with deepening the well, probably less than 25 feet, would have been much less than that incurred in obtaining other small temporary supplies.

It must at least then be conceded that the lower part of the Middle Lias under Northampton is not impervious, although it may not be as porous as the Rock-bed.

It must be borne in mind that when water gets into a porous bed in which there are no open fissures, there immediately commences a struggle between capillarity and gravity, and no water will flow till the capillary-holding power of the rock is satisfied; afterwards the flow of water depends upon the size of the interspaces between the particles, which interspaces are, of course, proportional to the size of the particles. A stiff clay consists of such small particles that the interspaces are minute enough to retain all the water that can get in, consequently, when a clay is once thoroughly wetted, no more water can pass downwards through it.

Clay, although impermeable, will often contain 10 per cent. of water by weight, and when apparently quite dry, often more than half that amount. I have made these remarks because it seems to be rather a common belief that water only travels in the Middle Lias by means of open fissures, whereas the great mass of the rock is engaged in supplying these fissures with water.

(To be continued.)

THE PRINCIPLES OF BIOLOGY.

BY HERBERT SPENCER.

PART V.—"PHYSIOLOGICAL DEVELOPMENT."

EXPOSITION OF CHAPTERS I. TO V.

BY KINETON PARKES.

In discussing the problems of physiology generally Mr. Spencer reminds us that we must use the word "physiology" in a sense co-extensive with the sense in which the word "morphology" was used in the previous part.

The various processes of animal and plant life must be considered in a way analogous to that in which their structures were considered. So that in this consideration the words have a far greater significance than is generally attributed to them. They are used to include respectively "All the general phenomena . . . . which illustrate the processes of integration and differentiation characterising evolution in general," and "the evidences of those differentiations and integrations of organic functions which have simultaneously arisen."

The enquiry pursued in these chapters is "How heterogeneities of *action* have progressed along with heterogeneities of *structure*," in them are traced out the various differentiations which have taken place in the life processes, and how these differentiations have been the accompaniment of the changes which have taken place in the bodies of the various organisms that are known to us. At the end of this enquiry we shall realise how fully life itself consists of "a definite combination of heterogeneous changes, both simultaneous and successive."

One of the first facts that is noticed, in a practical acquaintance with vegetable forms, is the difference between their external and internal parts. However lowly the organism may be, there is a clear distinction between the parts exposed to view and the parts enclosed by them. The plant "presents a contrast between its peripheral substance and its central substance." This difference may, indeed, be but slight, but it is inevitable. In whatever way the organism is viewed this fact appears first and prominently. The differences in the various species are naturally varied and numerous, but however unlike some of them may be they all agree in this one important particular, "a strong distinction between the parts in contact with the environment and the parts not in contact with the environment." It is to this fact, simple as it may seem, that differentiation of function is due.

In the consideration of the "differentiations among the outer tissues of plants," Mr. Spencer instances two forms of plant life, the *Protococcus* and *Volvox Globator*, two free forms. The *Volvox* is a complete sphere, and, consequently, no part of its outer surface is different to another, and forces act equally upon the whole of its exterior substance. This is anticipated by the hypothesis "If differentiations are occasioned by differences in the incidence of forces, then there will be no such differentiations where there are no such differences." On the other hand, considerable differences are noticeable where one end of any organism is attached to some object; then the differentiation is very great, because the difference in the incidence of the forces has been great also.

In the case of the Phanerogams the environments of the fixed part and the free part of the plant are entirely different. The root is buried in the ground; that is, its environment is the earth. The environment of the stem, branches, and leaves is the air.

It is needless to point out the differences between the roots of a tree and its stem and branches; they are obvious; but the question is, How came these differences to exist? If we take a cutting from a tree and place a portion of it in the earth, that part, if all conditions are favourable, speedily develops rootlets and root fibres; in fact, part of a stem has assumed the characteristics and the functions of a root. And to what is this change due? To the altered environment, and to the incidence of different forces. But, as Mr. Spencer says, "the most conclusive evidence is furnished by the actual substitutions of surface-structures and functions that occur in aërial organs, which have taken to growing permanently under ground, and in underground organs which have taken to growing permanently in the air. On the one hand, there is the *Rhizoma*, exemplified by ginger. . . . . On the other hand, there are the aerial roots of certain orchids." We have here an answer to the question ; an explanation of those causes which bring about the changed conditions.

A most important matter is such differentiation of tissues as shall form organs for the production of seed, in order to perpetuate the species. The consideration of many facts in the study of vegetable physiology leads to the conclusion that the process of "gamogenesis commences where the forces that conduce to growth are nearly equilibrated by the forces that resist growth ; and the induction that in plants, fertilised germs are produced at places where there is an approach towards this balance" is found "to be in harmony with the deduction that an advantage to the species must be gained by sending off migrating progeny from points where nutrition is failing."

The agency of insects in the propagation of seed has been pointed out by Darwin, and its importance fully illustrated. Since Mr. Spencer wrote "The Principles of Biology" much has been done in this fascinating branch of study, by many of our most eminent naturalists. Fertilisation of flowers, by means of bees and butterflies, is the most popular form of looking at the subject, but there are many insects other than these whose importance in this respect is quite as great. Whatever results have been obtained from these studies have, more or less directly, added proof to the things Mr. Spencer has said.

Having dealt with the differentiations among the *outer* tissues of plants, we come to the consideration of "The differentiations among the *inner* tissues of plants." As we pass from plants of low organisation to those of a more complex structure, it is noticeable that the inner tissues begin to differentiate. The parts which were at one time homogeneous now begin to assume a heterogeneity of structure, and this change may be noted increasingly as we ascend from low to high forms. In the lower forms, where, as an instance, the organism may grow in a vertical position, but to no great height, the differentiations in the inner tissues do not require to be very extensive. A spiral vessel will answer the purpose very well as in a fern, or other similar vessels as in the flower-stem of the blue-bell or tulip. When, however, a higher stage is reached, as the stem of an endogenous or exogenous tree, in order to keep it vertical, and in order to keep its branches in the right positions, considerable differentiation must have taken place.

The function of circulation, and the formation of vessels, are matters which are part of this consideration. If at a certain place in a plant a large amount of sap is being consumed, it seems natural that a flow of sap should set in in the direction of that part. This includes circulation and the formation of vessels. But, as regards the latter process, two questions arise. Is a vessel a distinct formation ? or is it a number of cells which have coalesced (their partitions being removed) to form a vessel? The second method seems to be the more probable way. The contents of one cell would burst through its walls at the weakest point and enter the next cell, and this process would be continued till, at length, it resulted in the formation of the vessel. These are the more important subjects involved in the consideration of the inner tissues of the plant. In Chapter V. the "Physiological Integration of Plants" is dealt with, and we find that an increase of differentiation implies a corresponding increase of integration. In the lower forms of plant life there is little integration observable, but as higher forms are studied and physiological division of labour takes place, then integration is the accompaniment. "Always the gain of power to discharge a special function involves a loss of power to perform other functions," and, therefore, integration must take place in order to keep pace with differentiation.

"Thus, that which the general doctrine of Evolution leads us to anticipate, we find implied by facts. The physiological division of labour, among parts, can go on only in proportion to the mutual dependence of parts ; and the mutual dependence of parts can progress only as fast as there arise structures by which the parts are efficiently combined, and the mutual utilisation of their actions made easy."

NEW BRITISH MOSS.

I am pleased to report that *Dicranum undulatum*, Ehrhart, was found, for the first time as a British plant, near Great Wolford, Warwickshire, May 31st of this year. This I picked up whilst hurrying to catch a train, and as I did not recognise it until I reached home, I was unable to form an opinion as to whether it was abundant or otherwise. At the end of last week, however, I paid another visit to the locality, and found that the tropical heat of the last week or so had so shrivelled up the mosses that I had some difficulty in again finding my plant; but so far as a two hours' search would reveal, I think it must be recorded as very sparse in quantity. Possibly in the autumn and spring months of the year it may have been more abundant. Having unearthed it in this locality, I have great hopes of being able to find it in other parts of the same district, and have no doubt that it will be found on damp heathy spots in the Valley of the Evenlode, in Oxfordshire, and probably in the adjacent portions of Gloucester and Worcestershire. I at once forwarded specimens to Dr. Braithwaite, and the plant is fully and ably described in Part X., supplement, page 299, of "The British Moss Flora," and Dr. Braithwaite promises an illustration in the supplement of Vol. II. of the same work. The following is the condensed description of the moss:—"*Dicranum undulatum*, Ehrh. Dioicous; robust, densely tomentose. Leaves from a broad base, lineal-lanceolate, *strongly undulate, coarsely serrate at margin, and in two rows at back of nerve;* caps. aggregate, oblong-cylindric, arcuate; lid with a long subulate beak." "Brit. Moss Flora," page 299. The Wolford plant is barren. I think it will probably be found in other British stations, as it may have been overlooked as merely a barren state of *Dic. scoparium* or *Dic. palustre.*

J. E. Bagnall.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.

EXCURSION TO OXFORD.

On Whit Monday, May 30, an excursion of the members and their friends was taken to Oxford, by the 10.5 a.m. train from Snow Hill, arriving at Oxford at 12 noon, where the party were met by Mr. G. C. Druce, F.L.S., and Mr. G. Simms, of Oxford, who conducted them over the various places of interest in the city, and had made special arrangements for the reception of the party. After a light luncheon at the George Hotel, the party were conducted along Market Street into the Turl, seeing Lincoln, Exeter, and Jesus College fronts; and into the Broad, seeing Trinity and Balliol Colleges, and opposite Balliol the spot of the martyrdom, in 1555, of Bishops Ridley and Latimer, and Archbishop Cranmer; then along St. Giles', past the Martyrs' Memorial into Parks Road, where the Ashmolean Museum was visited, containing a very interesting collection of antiquities and relics; and then the Natural History Museum and Ethnological Museum. In the Natural History Museum, amongst the fine series of specimens illustrating Zoology and Geology, there was particularly noticed the attempt to give a perfect sequence of the evolution of life in different classes of the animal kingdom, especially in the Cephalopoda, which were present as they flourished on that very spot as the Ammonites of the Lias, and as the still living forms of Argo, Nautilus, and Octopus. The corals were lovely, and the models of these, and of the Actinoids, and of the development of the Echinoderms, were especially interesting. The glory of the collection was, however, the magnificent

Pentacrinus asteria, a stalked crinoid, from the West Indies, nearly two feet in height. Keble, the most recent college, founded in 1868, was then visited, where the party were courteously conducted by Canon Moore over the richly decorated chapel, the hall, and the library; and were shown Holman Hunt's celebrated picture, the "Light of the World," which has been presented to Keble College. Trinity and Wadham College Gardens were then seen, containing fine groups of large trees, including horse chestnuts in blossom; and the party proceeded to the Radcliffe Library, with its fine collection of modern English and foreign scientific literature; passing St. Mary's Church and Hertford College to New College, dating from as early as 1380 A.D., with its very fine chapel and cloisters, and large hall. In the gardens was seen the remaining portion of the ancient city wall, with its projecting bastions, and a picturesque view of Magdalen tower between the trees of the garden. High Street was then reached, and its grand sweep of fine buildings, terminating with the beautiful tower of Magdalen College; and the party were conducted by Mr. H. E. Garnsey, M.A., over the college, and its chapel, cloisters, and the pleasing water walks on the banks of the Cherwell. The Botanic Gardens were then visited, where the party were received by Professor Balfour, and shown by him over the houses, containing fine specimens of tropical plants, the museum, and botanical laboratory, and the library containing rare old books and the original drawings of standard botanical works, such as Sibthorp's "Flora Græca," and one of the two or three existing copies of the engravings of Dioscorides' plants, both of these left by Dr. Sibthorp to the University. The party then proceeded by Christchurch Meadow, along the Cherwell, to see the university barges on the Isis; and from thence by New Walk to the Cathedral, Christchurch College, the great Quad, and the celebrated "Tom" tower. After a substantial meal at the George Hotel, the party visited the beautiful and extensive gardens of St. John's and Worcester Colleges, with fine groups of trees and extensive shrubbery walks. Amongst the trees noticed during the day was a very fine cut-leaved alder, *Alnus incisa*, in New College Gardens; and in Christchurch Meadows were seen the last relics of *Fritillaria meleagris*. On the limestone walls the Oxford ragwort, *Senecio squalidus*, was seen, and the ivy-leaved toad flax, *Linaria cymbalaria*, was very abundant. The party then proceeded to the station, leaving by train at 8.12 p.m., and arriving at Birmingham at ten o'clock, having greatly enjoyed the visit, and been favoured with fine weather throughout.

MIDLAND UNION OF NATURAL HISTORY SOCIETIES.

ANNUAL MEETING AT MALVERN.

We beg to point out that the Annual Meeting for this year, at Malvern, is to be held on the 6th and 7th of July, being Wednesday and Thursday instead of the usual days of the week.

The Meeting of the Council is to be held at 12, and the General Annual Meeting at 3 p.m., in the Drill Hall, Albert Road.

At the Conversazione in the evening there will be various exhibitions of scientific interest and short addresses on points connected with the local Natural History and Antiquities.

The excursions on Thursday, the 7th of July, will be three in number, so arranged as to specially meet the requirements of Geologists, Botanists, and Archæologists, respectively.

The Geologists will visit various points of interest in the Malvern chain of Hills and the vicinity, including the very fine collection of local fossils made by Mr. Piper, of Ledbury.

For the Botanists, Twining Fleet and Bredon Hill will no doubt furnish a rich harvest of uncommon plants, while the Abbey at Tewkesbury, the almost unique Saxon Church at Deerhurst, and the ancient houses of Payn's Place and Birtsmorton will afford plenty of interesting material for the Archæological excursion.

Review.

A Modern Apostle, etc. By Constance C. W. Naden, Author of "Songs and Sonnets of Springtime." London:—Kegan Paul, Trench, & Co., 1887.

The pages of the "Midland Naturalist" are not usually open for the criticism of works of a purely literary character, and therefore the indulgence of its editors and readers is craved for this departure from precedent. But, on the other hand, the reviewer is of opinion that a perusal of the dainty volume of poems above mentioned, will not only justify the present notice, but will call forth the gratitude of readers for being introduced to it, especially as the contents of the volume are written on a sound scientific basis, such as that laid down by Mr. Herbert Spencer in his famous "Essays on Education," wherein, speaking of poetry, he says:—"Like music, poetry has its root in those "natural modes of expression which accompany deep feeling. Its "rhythm, its strong and numerous metaphors, its hyperboles, its "violent inversions, are simply exaggerations of the traits of excited "speech. To be good, therefore, poetry must pay attention to those "laws of nervous action which excited speech obeys. In intensifying "and combining the traits of excited speech, it must have due regard "to proportion—must not use its appliances without restriction; but, "where the ideas are least emotional, must use the forms of poetical "expression sparingly; must use them more freely as the emotion "rises; and must carry them to their greatest extent, only where the "emotion reaches a climax. The entire contravention of these "principles results in bombast or doggerel. The insufficient respect "for them is seen in didactic poetry. And it is because they are rarely "fully obeyed that so much poetry is inartistic."

It is not too much to say that throughout her present work the accomplished authoress has fully and faithfully followed the scientific canons of the distinguished author of the Synthetic philosophy. The writings of Miss Naden are not unknown in the pages of this Journal, and her able expositions of some of the cardinal points of the doctrine of evolution in addresses delivered before the Sociological Section of the Birmingham Natural History and Microscopical Society on "Special Creation and Evolution," and on "The Data of Ethics," have had a wider circle of admirers. Thoroughly schooled in the domain of evolutionary teaching—a psychologist of a very high order—and a poet by nature, with large sympathies in favour of progress and beliefs in its indefinite "survival," Miss Naden has, in this volume, presented her ripest and richest experience.

"A Modern Apostle" is, of course, the principal subject in the work, and it is a poem of great power and beauty, following a noble model—the "Isabella" of Keats. "The Story of Clarice" is a sweetly tender and touching lyric, absolutely true to the life of womanhood:—

> "When pain and anguish wring the brow,
> "A ministering angel thou!"

The "Evolutional Erotics," one of the lesser but not unimportant divisions of the book, include some brilliant touches of humour and satire, mingled with wisdom. The following splendid example will specially commend itself to the acceptance of all Darwinians.

We hail with gratitude the appearance of this beautiful volume as an addition to Miss Naden's laurels, and we confidently predict further triumphs for her both in poetry and philosophy.

SOLOMON REDIVIVUS, 1886.

What am I? Ah, you know it,
  I am the modern Sage,
Seer, savant, merchant, poet—
  I am, in brief, the Age.

Look not upon my glory
  Of gold and sandal wood,
But sit and hear a story
  From Darwin and from Buddh.

Count not my Indian treasures,
  All wrought in curious shapes,
My labours and my pleasures,
  My peacocks and my apes;

For when you ask me riddles,
  And when I answer each,
Until my fifes and fiddles
  Burst in and drown our speech,

Oh then your soul astonished
  Must surely faint and fail,
Unless, by me admonished,
  You hear our wondrous tale.

We were a soft Amœba
  In ages past and gone,
Ere you were Queen of Sheba,
  And I King Solomon.

Unorganed, undivided,
  We lived in happy sloth,
And all that you did I did,
  One dinner nourished both:

Till you incurred the odium
  Of fission and divorce—
A severed pseudopodium
  You strayed your lonely course.

When next we met together
  Our cycles to fulfil,
Each was a bag of leather,
  With stomach and with gill.

But our Ascidian morals
  Recalled that old mischance,
And we avoided quarrels
  By separate maintenance.

Long ages passed—our wishes
  Were fetterless and free,
For we were jolly fishes,
  A-swimming in the sea.

We roamed by groves of coral,
  We watched the youngsters play—
The memory and the moral
  Had vanished quite away.

Next, each became a reptile,
  With fangs to sting and slay;
No wiser ever crept, I'll
  Assert, deny who may.

But now, disdaining trammels
  Of scale and limbless coil.
Through every grade of mammals
  We passed with upward toil.

Till, anthropoid and wary
  Appeared the parent ape,
And soon we grew less hairy
  And soon began to drape.

So, from that soft Amœba,
  In ages past and gone,
You've grown the Queen of Sheba,
  And I, King Solomon.

W. R. H.

Wayside Notes.

Signs of the Times.—In the sermon preached by Dr. Boyd Carpenter, Bishop of Ripon, in St. Margaret's Church, Westminster, in relation to Her Majesty's Jubilee, before the Members of the House of Commons, on Sunday, 22nd May last, after referring generally to the progress of knowledge during the last fifty years, he said:—"The age was not prosaic which had given us enlargement of knowledge and power, which had witnessed three discoveries, any of them equal to the discovery of the laws of motion—the discovery, he meant, of the doctrine of evolution, of the conservation of energy, and of the subtle molecular movement in the physical world, and which had given us Darwin and Spencer, Huxley and Tyndall, M'Clintock, Stanley, Baker, and Speke; he did not call that age prosaic which had drawn men together in closer bonds, extended its enfranchising hand to every creed, stood with tenderer care to the needy and the unfortunate, cherished the fallen, provided for the insane, abolished duelling, and mitigated war; which was the age of Florence Nightingale, of Sister Dora, of Agnes Jones, and Octavia Hill; which had shown us martyrs of science like Brewster and Professor Palmer; martyrs and heroes of the faith like Livingstone, Paterson, Hannington, and Moffat; heroes, too, of the battlefield that had left us records great and heart stirring, like the marches in Afghanistan, in Egypt, and the stories of Balaclava and Rorke's Drift." The above extract is taken from the "Times" newspaper of 23rd May last, the editor of which characterised the sermon as being "remarkable for its power, its brilliancy, and its sustained eloquence."

The Death of Bernard Studer, of Berne, the Swiss geologist, at the ripe old age of ninety-three years, carries back our thoughts almost into the pre-historic period of geological theories. Ninety-three years ago the war between the Vulcanists and Neptunists, as the advocates respectively of universal volcanic and universal aqueous origin of rocks were known, still raged with hardly diminished fury, though the names themselves had hardly as yet become terms of reproach. Hutton had as yet only published in preliminary form his views, now known as the Huttonian theory of the earth, declaring that "the ruins of an older world are visible in the structure of our planet; and the strata, which now compose our continents, have been once beneath the sea, and were formed out of the waste of pre-existing continents," variously modified by forces either mechanical or chemical, igneous or aqueous, and which forces are still existing and acting. Even William Smith, with whom British classificatory geology practically begins, had only two or three years before published his "Tabular View of the British Strata" (1790), and his great map was not published till more than a score of years after. Studer seems to have been the William Smith of Swiss geology, and his greatest work was the publication, in conjunction with A. Escher von der Linth, of a geological map of Switzerland. Perhaps an equally high distinction is, however, to indicate him as one of the very first to study physical geography from the geological point of view.

LOCAL READERS will probably be much interested in a series of articles, entitled "A Review of Lighthouse Work and Economy in the United Kingdom during the past Fifty Years," which Mr. J. Kenward, well known and highly honoured in Birmingham scientific circles, is contributing to the columns of "Nature," the first of which appeared on June 2.

THE PRESERVATION of Alpine plants has entered into a new phase. In spite of the strenuous efforts of M. Correvon, and the society which he founded, many of the beautiful Alpine flowers, especially the edelweiss and the Alpine rose, are in danger of becoming extinct. The government of Valais and the Monte Rosa section of the Alpine Club have caused gardens to be laid out and inclosures to be made for the cultivation and protection of these plants. The station on the Tête du Mouton, near Vissoye, in the Einsicht Valley (Valais), situated at the height of 2,300 metres, cultivates not only plants belonging to the Alps, but some from the Pyrenees, the Himalayas, and the Caucasus.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—GEOLOGICAL SECTION, May 17. Mr. T. H. Waller, B.A., B.Sc., chairman. The secretary reported the receipt of the annual volume of "Proceedings of the Palæontological Society" in exchange. Mr. Bagnall (on behalf of Mrs. Coker Beck, President of Chiltern Natural History Society) exhibited *Hypnum Kneiffii* (Wimpstone Fields), *Cerastium tetrandum*, *Taraxacum erythrospermum*, *Trifolium subterraneum*, *&c.*, from Bournemouth. A paper of considerable interest was read by Mr. W. P. Marshall, M.I.C.E., on "The recent Riviera Earthquake, with particulars from eye-witnesses." At the close of the paper an interesting discussion was opened by Mr. Evans, a visitor introduced by Mr. Walliker, who was present at Mentone during the earthquake and subsequently. Mr. Evans complimented Mr. Marshall upon the faithfulness of his description of the earthquake phenomena, and gave a graphic and dramatic account of his experience of the earthquake and its effects. A cordial vote of thanks was given to Messrs. Marshall and Evans.—MICROSCOPICAL SECTION, June 7. The president (Prof. W. Hillhouse, M.A.) in the chair. A letter was read from Prof. P. H. Gosse, F.R.S., in which he said the following species of Rotifera (all, till then, undescribed) were sent him, within the last year or two, by Mr. T. Bolton, F.R.M.S., from Birmingham :—*Philodina tuberculata*, *Copeus labiatus*, *Furcularia micropus*, *Rattulus helminthodes*, *Pterodina reflexa*, *Asplanchna eupoda*, *Distyla eupoda*, *Pedetes Saltator*, *Furcularia Boltoni*, *Mastigocerca Lophoessa*, *Diaschiza cupha*, *Notholca polygona*, *Diglena polygona*, *Anuræa polygona*. The last three are not yet published. Mr. Horace Pearce, F.L.S., F.G.S., exhibited rock from Place Fell, Ulleswater, specimens of granite from Shap Fell, rocks from near the summit of Scafell Pike, and volcanic rock from the summit of the Great Gable, Cumberland. Mr. J. Udall exhibited a selection of banded slates, breccias, and hornstones from Charnwood Forest. Miss Taunton exhibited a collection of photographs of countries round the Mediterranean, also some interesting specimens of plants from the same localities. Mr. W. B. Grove, B.A., exhibited the following fungi, from North Wales: —*Œcidium leucospermum*, *Œ. lapsanæ*, *Puccinia anemones*, *P. umbilici*, *Trichobasis Scillarum*, *Uromyces ficariæ*, and *Entyloma ficariæ* from the neighbourhood of Dolgelly; and *Œcidium grossulariæ*, from Menai Bridge. Mr. W. P. Marshall, M.I.C.E., read the report of the Oxford excursion on Whit Monday. Mr. T. H. Waller, B.A., B.Sc., gave an exhibition of rock sections, illustrating the process of devitrification of volcanic glasses, which he described and further explained by thin sections under a series of microscopes.—Biological Section, June 14. Mr. R. W. Chase in the chair. Professor Hillhouse gave a paper on "Investigations into the Function of Tannin in the Vegetable Kingdom," describing an extensive series of several hundred experiments that he had made in the investigation of the subject. The conclusions arrived at are that tannin is an intermediate product between glucose or sugar and starch, and is left as a bye-product in the formation of starch, and remains inert without being used up in the process of growth. In the fallen leaves of winter the starch is found to have been all transferred, but the tannin that has been formed remains in them without diminution.—A specimen was exhibited by Mr. Bagnall of a wall-flower with abnormal flowers, in which the petals and stamens were absent, and the calyx and pistil were doubled. Mr. Edmonds exhibited an abnormal tulip flower, which had one of the petals displaced and situated 1½ inches below the others. Mr. Marshall exhibited *Sagitta bipunctata*, dredged in the Menai Straits, a very transparent object of much interest, allied to the nematode worms; also, *Hippolyte varians*, a small stalk-eyed crustacean, dredged at Colwyn Bay. Mr. Chase exhibited *Phormium tenax*, the New Zealand flax; and Mr. Bolton exhibited a specimen of the cowberry, *Vaccinum vitis-idæa*, from Cannock Chase.—Sociological Section, May 5. "On the Effect of Complexion in the Constitution of Offspring," by by Mr. W. H. France.—May 19. On Mr. Herbert Spencer's essays on "Beauty" and "Use and Beauty," by Mrs. Alfred Browett.—May 24. On "Data of Ethics (Psychological and Sociological Views of Conduct)," by Mr. W. R. Hughes, F.L.S. An interesting discussion followed the reading of each of the above papers.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY. —Section D, Zoology and Botany. Chairman, F. T. Mott, F.R.G.S. Evening Meeting, June 15; attendance twelve (three ladies). A vote of thanks to the retiring chairman was moved by Dr. Cooper, and carried unanimously. The chairman reported that at the Field Day last week five members went to Swannington Bog, and collected a good many of the less common plants, among them *Scirpus pauciflorus*, *Eriophorum polystachion*, and the fine moss *Hypnum commutatum*; all of them recorded previously for this station, but for very few other places in the county. The following objects were exhibited, viz.: by Dr. Finch, three distinct forms of the purple lilac, and a number of other garden plants; by Dr. Cooper, specimens of *Claytonia perfoliata* and *alsinifolia*, and of *Potentilla verna* from Wales; by Rev. T. A. Preston, *Asarum Asarabacca* in flower, and several abnormal cabbage leaves, some funnel-shaped and one pair grown together along the mid-rib. Mr. Carter reported that Miss Ridger, of Ashley, had found *Vaccinium* *vitis-Idæa* in flower, on Charnwood Forest, a plant never yet recorded in this county. Rev. T. A. Preston, M.A., opened a discussion on the zero temperature of vegetation. He said it was now an accepted doctrine that about 42° Fahr. was the temperature below which vegetable growth could not take place; that as soon as the temperature rose above that point cell-formation began; that the amount of growth depended mainly upon the length of time during which a plant was exposed to such higher temperature, and the total number of degrees above 42 by which it was affected during that time; and that different plants required different numbers of such degrees to bring them to maturity. He was not himself quite satisfied with this theory. He had collected and recorded phenological observations for a long series of years, and he thought the theory would require some modification. The discussion was continued for some time. The Rev. T. A. Preston then read a short paper on "*Carduus tuberosus*, a rare British Thistle," which was illustrated by a number of dried specimens of this species and of its nearest allies, *C. pratensis* and *C. acaulis*. This thistle appeared only to exist in England in the county of Wilts, and the early records of its appearance there were curiously inconsistent. It now grew at Avebury, and, possibly, in one or two other localities. Some supposed it to be a hybrid between *pratensis* and *acaulis*. It had the habits of the first, and the divided and serrated leaves of the second, but was distinguished by the fusiform tubers of the root.

CARADOC FIELD CLUB (SHROPSHIRE).—The first meeting of the season was held on Friday, May 27th, in conjunction with the Severn Valley Club. The locality chosen was Wenlock Edge, and the special point of rendezvous was Larden Ditches, a large encampment, probably of British origin, and still showing a triple entrenchment. On their route the members of the party paid a visit to no less than three fine specimens of sixteenth century manor houses—Wilderhope, the ancient seat of the Smalman family, and Shipton and Larden Halls, which belonged respectively to the Myttons and the Mores, and are now both the property of Mr. Jasper More, M.P., who, in company with Sir Charles Rouse Boughton, kindly acted as guides on the occasion. The characteristic geology of the neighbourhood was pointed out by the Rev. J. D. La Touche, the president of the Caradoc Club, and several exposures of Upper Ludlow Shale furnished many characteristic fossils. A few plants of some rarity were found, but the day was marred by a succession of cold showers, which were more favourable to the development of mud than the pursuit of science.

DUDLEY AND MIDLAND GEOLOGICAL AND SCIENTIFIC SOCIETY.—This Society held their second meeting for this season on Tuesday, 14th June, at the Abberley Hills. The party, consisting of upwards of thirty members and friends, with Mr. H. Pearce, F.G.S., president, drove from Kidderminster to Witley, and were conducted through Witley Court and grounds by Canon Melville. They then visited an interesting outlier of Wenlock Limestone in the grounds of Abberley Hall, where a number of fossils were found, among which may be mentioned *Heliolites Murchisoni*, *Favosites Forbesi*, *F. Gothlandica*, *Monticulipora*, *Cyathophyllum*, *Rhynchonella cuneata*, *Strophomena rhomboidalis*, &c. The party then walked to a quarry of

Aymestry Limestone on the Bromyard Road, where the lie of the beds is reversed, and the Upper Ludlow Rocks rest on Old Red Sandstone, which is inclined uncomformably against the vertical beds of the Aymestry Limestone. The Abberley Hills form the northern end of that long axial line of disturbance which extends along the Malvern Range, and the contrast of the scenery on the east and west sides of the hills is very remarkable, as showing plainly that this is caused by the difference in the geological formations. On the east stretch the flat sandy plains of the Severn Valley, consisting of New Red Sandstones and Marls, whilst on the west the eye is delighted with well-wooded hills and undulating ground of Old Red age. The party afterwards ascended Abberley Hill, and obtained a pretty fair view of the surrounding country. Mr. H. Pearce exhibited *Ranunculus parvus*, from Broome, Worcestershire, and the following plants from the Lake district:—*Asplenium viride*, *Alchemilla alpina*, from Mardale, and *Antennaria dioica*, from Long Street Mountain.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—May 16th. Mr. H. Insley referred to the loss the Society had sustained by the death of the late Mr. J. H. Baxter (one of the first members of the Society), which took place on the 3rd instant. Mr. J. W. Neville, in moving a vote of sympathy with his family and friends, spoke of the genial manners and devoted zeal that endeared him to all fellow-workers—a zeal that was manifested through a protracted illness, and only terminated by death. Mr. J. Madison exhibited a curiously-spotted frog, taken from an elevated part of Snowdon; Mr. J. W. Neville, a specimen of the rose of Jericho, *Anastatica hierochuntica;* Mr. H. Insley, fasciation of wallflower, comprising sixteen stems; Mr. Hawkes, *Œcidium tragopogonis* and specimens of *Claytonia perfoliata;* Mr. F. Shrive, skin of cobra di capello.—May 23rd. Mr. J. Moore exhibited specimens of *Planorbis dilatatus;* Mr. Hopkins, pupa of *Chœrocampa elpenor;* Mr. J. Madison, rock specimens from Snowdon; Mr. A. T. Evans, a rock specimen, showing the junction of granite and basalt, from Charnwood Forest. Under the microscope, Mr. H. Insley showed a series of slides of marine algæ, and described their methods of fructification; Mr. Dunn, organs of locomotion of earthworm.—June 6th. Mr. J. Collins was elected a Vice-President in the place of Mr. C. F. Beale, who resigned on account of his removal from the district. Mr. H. Insley exhibited a spray of American cotton plant; Mr. J. Madison, a series of specimens of *Limnæa peregra* from Llyn-y-fan-fach, Caermarthenshire; Mr. J. W. Neville, a specimen of sea mouse. Under the microscope Mr. F. Holden showed a slide containing fifty-six species of desmids.—June 13th. Mr. H. Hawkes showed a number of micro-fungi, including specimens of *Œcidium allii*, *Trichobasis petroselini*, and *Entyloma ungerianum;* Mr. J. Madison, the following shells: *Succinea putris*, *S. virescens*, *Ancylus fluviatilis* var. *gibbosa*, and *Limnæa truncatula*, all from Caermarthenshire. Mr. P. T. Deakin, fourteen species of land shells collected between Caermarthen and the Black Mountain. Mr. C. P. Neville then read a paper, "Notes on the Butterflies of Cardiganshire," in which the writer gave the results of his collecting during many summer visits. The district was not rich in varieties, about twelve species only being commonly met with. A small collection of butterflies and moths was exhibited.

MIDLAND UNION OF NATURAL HISTORY SOCIETIES.

The Tenth Annual Meeting of the Midland Union of Natural History Societies was held on July 6th and 7th at Malvern. The Meeting was a fortnight later than has been usual, owing to the Jubilee celebrations, which rendered the earlier date unsuitable. To this circumstance must be partly ascribed the small attendance, as several who would otherwise have been present were away from home.

The Council met in the Drill Hall, Albert Road, at 12 noon, and after receiving the usual reports adopted the Annual Report for presentation to the General Meeting.

The report on the subject of the Darwin Medal stated that only one paper in the specified subject (Archæology) had been submitted, but the Adjudicators unanimously considered it worthy of the prize, and the Council accordingly awarded the medal to Mr. E. W. Badger, M.A., for his paper on "The Monumental Brasses of Warwickshire."

A notification was received from the Secretary of the British Association that the Midland Union has been retained upon the list of the Corresponding Societies of the Association, and requesting that a delegate to the Manchester Meeting should be appointed; and the Council appointed H. Wilson, Esq., the Secretary of the Malvern Field Club, as delegate.

Mr. H. J. Eunson, the delegate from Northampton, invited the Union to meet in Northampton in 1888, and it was resolved to recommend the General Meeting to accept the invitation.

The attention of the Council was called to the very small use which the Societies composing the Union make of the *Midland Naturalist* for the publication of their proceedings, and the Hon. Sec. was directed to send a circular to the Societies on the subject, and to urge them to a more general subscription to it. The numbers taken by most of the Societies are extremely small, and the Council believes that the journal is worthy of much more support from our various Clubs and Societies than it at present obtains.

The Annual General Meeting

was held in the Drill Hall at 3 p.m. After the minutes of the Shrewsbury Meeting had been read and confirmed, the President, Rev. G. E. Mackie, M.A., delivered an address on the "Difficulties of Field Clubs," with suggestions as to how these may best be met, especially urging that the fundamental idea that the meetings are really for the prosecution of

Natural History work, and for mutual help of the members, should be adhered to as strictly as possible, and that the social element, which is so apt to overpower the scientific, should be kept in its right (subordinate) place.

Several members spoke on the topics touched upon by the President, and a hearty vote of thanks was accorded to him for his address.

The report from the Council was then read, as follows:—

Societies in the Union.

One Society, that by whose invitation we are holding the present Meeting, has joined the Union during the year, and the list of the Societies now composing it will be as follows:—

Birmingham Microscopists' and Naturalists' Union.
Birmingham Natural History and Microscopical Society.
Birmingham Philosophical Society.
Birmingham and Midland Institute Scientific Society.
Birmingham School Natural History Society.
Caradoc Field Club.
Dudley and Midland Geological and Scientific Society and Field Club.
Evesham Field Naturalists' Club.
Leicester Literary and Philosophical Society.
Malvern Field Club.
Northamptonshire Natural History Society.
Nottingham Working Men's Naturalists' Society.
Oswestry and Welshpool Naturalists' Field Club.
Peterborough Natural History and Scientific Society.
Rugby School Natural History Society.
Severn Valley Naturalists' Field Club.
Tamworth Natural History, Geological, and Antiquarian Society.

The Council, however, regrets to report that the Peterborough Natural History and Scientific Society has given notice that the considerable distance at which their city lies from the other towns at which meetings are held, and some changes in the circumstances of the Society, will compel them to withdraw after this year.

Darwin Medal.

The subject for the present year is Archæology, and the following gentlemen kindly undertook to act as adjudicators, viz., The Very Rev. J. J. Stewart Perowne, D.D., Dean of Peterborough; M. H. Bloxam, Esq.; Jno. Amphlett, Esq.; W. H. Duignan, Esq.; and J. A. Cossins, Esq. The reports received from them all speak in high terms of the value and interest of the only paper which was submitted to their consideration as complying with the conditions of the prize, and they comment upon the care and ability evidenced in the preparation of it. The Council have therefore awarded the Darwin Medal for this year to Mr. E. W. Badger, M.A., for his paper on "The Monumental Brasses of Warwickshire."

"Midland Naturalist."

The "Midland Naturalist" has, we consider, maintained a high standard of excellence in the character and value of the papers published. During the year there has been a change in the Editorship. We still retain the valuable services of Mr. E. W. Badger, to whom, as in the past, our most hearty thanks are due for his exertions in the work; but Mr. W. J. Harrison, to whom we have from the very beginning been so much indebted for the success which has been attained by the "Naturalist," who has given to the editing of it so much of his time, in writing, collecting materials, and the various duties of the office, has frequently during the last few years, as will be remembered by the Union, expressed his desire to be relieved of the post. Early in this year the opportunity occurred of securing the services of Professor W. Hillhouse, M.A., F.L.S., of the Mason College, the President for this year of the Birmingham Natural History and Microscopical Society, and Mr. Harrison again tendered his resignation, which the Committee accepted, passing at the same time the following resolution:—"That this Committee desires to express its most hearty thanks and those of the Midland Union for Mr. W. J. Harrison's services as co-editor of the 'Midland Naturalist' since its beginning in 1877, and to record its feeling of the value of those services in connection with it."

Professor Hillhouse entered upon his duties with the number for March, and the Council is confident that the high character of the journal will be perfectly safe in his hands.

The papers which have been published since the last meeting have been fully equal in interest and importance to any which have appeared of late years. The following are the titles of some of the principal:—

The Monumental Brasses of Warwickshire, by E. W. Badger, M.A.; A Three-eyed Reptile, by A. B. Badger; A Proposed Midland University, by Professor W. Hillhouse, M.A., F.L.S.; The Relations between Evergreen and Deciduous Trees, by F. T. Mott; Micro-organisms in a Swampy Ditch in Sutton Park, by T. Bolton; Fungus Hunting in Spring, Leafing of Oak and Ash, The Boleti of the Birmingham District, by W. B. Grove, B.A.; An Excursion to Tenby, Notes on an American Tour, The Causes of Glacial Motion, and Tresca's Investigations into the Flow of Solids under Great Pressure, by W. P. Marshall, M.I.C.E.; History of the County Botany of Worcester, by Wm. Mathews, M.A.; Ragnarok, by G. Deane, D.Sc.; various expositions and discussions of Herbert Spencer's Works, by Miss C. Naden, C. H. Allison, F. J. Cullis, F.G.S., W. B. Grove, B.A., Professor W. Hillhouse, and W. R. Hughes, F.L.S. B. Thompson, F.G.S., has continued his paper on the Middle Lias of Northamptonshire, with special reference in the more lately published parts to the water supply of Northampton. The address delivered to the Birmingham Natural History and Microscopical Society by the retiring President, R. W. Chase, of the British Ornithological Union, well deserves a careful study from all our members, dealing as it does with subjects so suitable for the consideration both of the Union as a whole and of the separate Societies as the proper principles and limits of Local Museums and their relation to Local Natural History Societies, and the preservation of our English birds by some properly considered scheme of egg protection.

The list of papers given above, however, by no means adequately represents the work done by the component Societies during the past year. Some of them publish Transactions separately, and to this number the Leicester Literary and Philosophical Society has recently been added. The three quarterly numbers already published contain many very interesting and valuable papers on Biology, Geology, Archæology, &c., and the Society has published by a sub-committee a

Flora of Leicestershire, which will no doubt be welcomed by botanists, and is an example of the useful work which enthusiastic naturalists may undertake in many branches of knowledge.

The Meeting of the British Association in Birmingham last year was naturally attended by many of our members, and several papers on the local Natural History were contributed by them both to the Handbook to the Birmingham district, which was prepared for the use of the Association, and to the Sectional Meetings. Among these, we may mention the papers on Heredity in Cats with an extra number of toes, and on the Artificial Production of a Gilded Appearance in certain Lepidopterous Pupæ, by E. B. Poulton, M.A.; Preliminary Notes on the Autumnal Fall of Leaves, by Professor W. Hillhouse, M.A., F.L.S.; on the Geology of the Birmingham District, by Professor Charles Lapworth, LL.D., F.G.S.; on a Deep Boring for Water in the New Red Marls, near Birmingham, by W. J. Harrison, F.G.S.; The Rocks between the Thick Coal and Trias, North of Birmingham, and the old South Staffordshire Coalfield, by Frederick G. Meacham, M.E., and H. Insley; on the Halesowen Coalfield, by W. Mathews, M.A., F.G.S.; and A Report on the Erratics of the Midlands, by Rev. H. W. Crosskey, LL.D.; the Fossiliferous Bunter Pebbles contained in the Drift at Moseley, &c., by A. T. Evans; the Extension and Probable Duration of the South Staffordshire Coalfield, by H. Johnson; the Ordovician Rocks of Shropshire, by Prof. C. Lapworth, LL.D.; Provincial Museums: their Work and Value, by F. T. Mott.

The Societies of the Union were also invited by the Secretaries of the various Committees of the British Association to render to these Committees any help which they might find in their power, and, we believe, a considerable number of our members responded to the request.

During the winter a beginning was made, though in a very tentative manner, with a scheme for the delivery of lectures, or the reading of papers among the Societies of the Union by visitors from other towns. A few visits were thus arranged for, but the season was already too far advanced when the subject was brought before the notice of the members, and the replies which did come in were in several cases too late to do anything with for the present. We believe that such an inter-visiting of members of the various Societies in the Union would be found to stir up an interest in Natural History among the younger members, to whom we must look to take the places of those who, as the years go by, must in the course of nature pass away, whose removal in so many cases so seriously cripples the work of local Societies, especially where these are small.

In reviewing the whole course of the Union for the year, we are confident that there is no need for despondency as to the work that is being done. There is abundant evidence that in spite of the heavy pressure on mind and body, which is so increasingly exerted by business engagements at the present day, possibly even in some cases as a relief from this pressure, many turn to the study of Nature with eagerness, and find still as ever that "Nature never doth betray the heart that loves her." Our office as a Union is to make it easier for anyone who is attracted to such study to discover what has been and is being done in the same field; to place, as far as possible, the knowledge and experience of all at the disposal of each one.

The Treasurer's report showed a balance in hand of £22 0s. 9d., as against £18 2s. 2d. last year, so that the financial position of the Union was considered very satisfactory.

The invitation to meet in Northampton in 1888 was then considered, and it was unanimously resolved that the invitation be accepted; the exact date to be fixed later on.

Mr. E. de Hamel was re-elected as Treasurer, and Messrs. T. H. Waller and H. J. Eunson as the Secretaries for the coming year.

Votes of thanks to the Malvern Society, to the officers of the Union, and to the President for presiding, concluded the proceedings.

Owing to a very unfortunate concurrence of circumstances the usual Conversazione was not held, and it was agreed at the General Meeting to substitute for it a drive round the North end of the Hills, partly to inspect a very interesting find of the Black Cambrian Shales, with characteristic fossils, which has recently been made in sinking a well.

The arrangements having been unfortunately upset, owing to the absence from home of the local Secretary, and a regrettable misunderstanding as to what was required in the way of preparation from the local Society, it was suggested at the General Meeting that it would be well to have a clearly defined account prepared and printed of what was really needed in the case of any Society preparing for a Meeting of the Union, and that the Executive Committee might appoint a small Committee to have the general care of the preliminary arrangements.

Excursion.

It had been arranged that on Thursday, July 7th, the members of the Midland Union assembled at Malvern should divide themselves in three directions; one party to botanise on Bredon Hill, an outlier of lias and oolite midway between the Malverns and the Cotswolds; another to "archæologise" at Tewkesbury and the Saxon church of Deerhurst; and the third to study the Geology of the Hills. However, from various causes the last-named Excursion only was carried out, about forty members uniting under the guidance of the local President.

A portion of the programme had been anticipated on the previous evening by a visit to the Syenitic Quarries of the North Hill, and to the Cambrian Shales recently found at the extreme northern end of the range. These shales have long been known at the south end of the Hills, where they are altered and upheaved by trappean intrusions of (probably) lower Silurian age; but they had not previously been found further north. The patch now found in sinking a well at North Malvern seems to have been preserved in a gully of the gneiss from the general denudation effected by the northerly currents of the Silurian Seas. The Section is as follows, in descending order:—

1.—Surface gravel	12 ft.
2.—Red crumbling marl, with small pebbles ...	24 ft.
3.—Coarse grey and red sandstones and conglomerates	16 ft.
4.—A very hard breccia of quartz pebbles in a red and yellow matrix	6 ft.
No fossils have been found in these three beds, which seem to be all of Permian age.	
5.—Black Cambrian shales, with Olenus, Conocoryphe, Lingulella, &c.	9 ft.

The beds dipped at an uniform angle of about 50°.

It is to be regretted that the well was not dug deeper; for the boring rod, which was carried 22 ft. further, penetrated through nine more feet of shale and thirteen feet of red rocks, apparently a repetition of beds (2) and (3) above. In any case the discovery is one of considerable interest. It is to be hoped that some attempt will be made to correlate these and the other Cambrian beds of Malvern with those recently discovered near Nuneaton, which appear greatly to resemble them.

Thursday's work for the members of the Union began about ten o'clock, with an inspection of the patch of Trias still clinging to the eastern side of the Hills, where, behind the Belle Vue Hotel stables, members noted the bright red Bromesberrow (Bunter) Sandstone, with characteristic stains of manganese, the rest of which is thrown down many hundred feet under the Keuper marls, which now cover the whole eastern plain.

The whole party then drove in two brakes to Mr. Canning's house at The Wyche, where, on the other or western side of the Hills, a similar relic of Upper Llandovery Sandstone, with Pentamerus and Petraia, was pointed out to them, adhering to the syenitic gneiss.

The next halt was made at the Camp Inn, where the great British Camp of the Herefordshire Beacon was visited. Close to here is the residence of Madame Goldschmidt (Jenny Lind), in whose grounds is a remarkable quarry shewing the foliation of the gneiss, and also a capping of Upper Llandovery Rock.

From here a long drive down the beautiful crest of Wenlock rock called the Ridgway, where members had pointed out to them a misletoe-bearing oak, led to Eastnor Castle and thence to Ledbury. Lunch was served at the Feathers at two o'clock. After the usual congratulatory speeches, an adjournment was made to the museum of G. H. Piper, Esq., Vice-President of the Malvern Field Club, who exhibited his splendid collection of Silurian and Old Red remains. Some specimens of Auchenaspis, with the body complete, are, we believe, unmatched.

The party then divided; some going under the guidance of the Rev. T. Auden to visit Ledbury Church, a Norman nave with Early English and Decorated additions, and a fine detached tower; while a few of the keener geologists accompanied Mr. Piper to the tunnel near the railway station, where he read a paper on the remarkable series there shown of Downton Sandstones, and passage beds between the Silurian and Old Red. These beds extend outside and above the tunnel in an unbroken section of over 900 feet, and show most completely the alternations of Silurian shales and limestones (containing trilobites, pterygotus, etc.), with Old Red marls and sandstones, containing Cephalaspis and other fish remains. Mr. Piper carefully measured these beds some years ago, before they began to be weathered and grass-grown; even yet they present a history of the transition between two great systems which cannot be surpassed anywhere.

The members were not fortunate enough to find any of the rarer fossils, but in the Ludlow and Aymestry rocks of the quarry just above, which form a downward continuation of the previous beds, many of the usual fossils were obtained. But the sound of the horn soon recalled all to the brakes, and after visiting Eastnor Church, they returned home by seven o'clock, after a very hot but most pleasant day.

HISTORY OF THE COUNTY BOTANY OF WORCESTER.

BY WM. MATHEWS, M.A.

(Continued from page 174.)

THIRD PERIOD, 1801 TO 1850.

It is not until the commencement of the present century that "*English Botany*" furnishes any new record for the County of Worcester. The period opens with the discovery of Festuca Calamaria (*F. sylvatica, Vill.*), as related in Vol. 14 of that work, 1802, where, under No. 1,005, Sir James Smith writes, "*Mr. Moseley, of Glasshampton, favoured us lately with living plants from the ledges of a lofty red sandstone rock in*

Shrawley Wood near his residence." The plant has been diligently searched for in this locality, but has not been seen there for upwards of 40 years.

Turner and Dillwyn's well-known "*Botanists' Guide*," in two volumes, with lists for each county in England and Wales, was published in 1805. The Worcestershire list, Vol. II., p. 656, contains 70 species only, mainly on the authorities of Merrett, Hudson, Nash, Withering, Stokes, and Ballard. Dr. Sheward's Catalogue in Nash's Supplement, 1799, seems to have escaped notice. It yields only the following new records:—

Turritis glabra. Near Stourbridge. Rev. W. Wood.

Epilobium angustifolium. Near Bewdley. Mr. Dyer.

Gnaphalium margaritaceum. By a rivulet in the heart of Wire Forest. Rev. Mr. Butt.

Alisma natans. Near Tenbury. Mr. A. Aikin.

A passing reference must now be made to a work mentioned by Mr. Lees, at p. 116 of his Botany of Worcestershire. This is the "*Agriculture of Bromsgrove*," by J. Carpenter, of Chadwick Manor, near Bromsgrove, Vol. I., 1803, Vol. II., 1805. I have not seen this book, but Mr. Lees informs me that it contains an engraving of two plants, described as very injurious to cattle. One is the Meadow Saffron; the other, which Carpenter calls "*Stavesacre*," appears from the plate to be the Larkspur. Of the latter he writes, "*This plant grows in some parts of this county, but wherever seen, care should be taken to prevent its future growth.*"

It may be well to insert here a correction for which I am indebted to my excellent friend, the Rev. J. H. Thompson, of Cradley. He tells me that I was in error in writing that "the Larkspur has not been seen within the County by any living Botanist." He has furnished me with the following records of specimens gathered by himself and now in his herbarium:—

1844. Holt.
1852. September 3rd. Cornfield at east end of Craycombe Hill; apparently wild.
1871. August 5th. East side of Hartlebury Common.
1885. July 23rd. Near Churchill Viaduct.

He adds that in every case except the second the plants were probably escapes from cultivation.

From Carpenter we pass naturally to William Pitt and his "*General View of the Agriculture of the County of Worcester*," one of the series of reports previously mentioned, published by order of the "*Board of Agriculture*." Pitt lived at Pendeford, about 4 miles north of Wolverhampton, and subsequently in Birmingham. His Survey of the County of Worcester was made in the years 1805, 1807; the published volume bears the date 1810. At page 317 is "*a list of the most remarkable vegetable productions of the county of Worcester, observed in a tour through the county in September and October, 1805, with a few from other authorities.*" It is refreshing to find at last, from an independent observer, records of agrarian weeds and other common plants. Even of these the list is very incomplete, probably owing to the time of year at which the tour was made, and our trust in the botanical knowledge of the author is somewhat shaken by the occurrence of such entries as "*Epilobiums, of sorts,*" "*Polygonums,*" and the like. It will therefore be necessary to examine some of the records in a more sceptical spirit than if they were from the pen of Withering or Stokes. Omitting Nash's plants, most of which are repeated, and a few others previously noticed in these pages, Pitt's list yields the following materials for our history:—

Clematis Vitalba. Hedges near Malvern, and north of Evesham.

Thalictrum flavum. Meadows and banks of rivers; meadows on Severn. Marshall.

Ranunculus repens.

Papaver Rhæas.

P. dubium.

† **P. hybridum.**

The last three plants are followed by the note "Poppies of sorts in cornfields." *P. hybridum, for which no locality is given, is a very doubtful record.*

Chelidonium majus. Hedges in Shrawley.

Sinapis alba. On the bank of the Leominster Canal, by the road side near Tenbury.

S. arvensis. Cornfields and turnip grounds.

"Three distinct plants are called chadlock by the farmers; which are wild mustard, wild radish, and wild rape. I found them all amongst turnips, in the common fields around Bredon Hill."

We must therefore add the two following species:—

Raphanus Raphanistrum.

Brassica Napus.

Sisymbrium Nasturtium. Watercress. Vale of Severn. Marshall

* **S. amphibium.** Water radish. Marshall.

* **Reseda Luteola.** On banks and rubbish.

Malva parviflora. Road sides and often near buildings.

Doubtless a misnomer for Malva rotundifolia, L.

Rhamnus Frangula. In hedges north of Evesham.

Ononis spinosa. Road sides, heaths, and rough ground.

Trifolium arvense. On sand, in the neighbourhood of Kidderminster, Mitton, and Stourport.

Agrimonia Eupatoria. Road sides.

Sanguisorba officinalis. In meadows.

Poterium Sanguisorba. On Bredon Hill; on very barren waste land near Church Lench ; on rich red loam near Inkborough, and in a meadow near Tenbury ; not yet common to be found in the county.

* **Rosa spinosissima.** Hedge near Worcester, on the Kempsey Road ; also on barren waste ground near Church Lench, north of Evesham.

The latter description confirms the identification of Merrett's species.

Lythrum Salicaria. Moist places.

Bryonia dioica. Hedges on sandy or gravelly soil, in the north of the county.

Sedum acre. Roofs and walls.

* **Saxifraga granulata.** Hedge bank near Kidderminster; dry pastures, Wolverley.

Peucedanum Silaus. A meadow plant.

Angelica sylvestris. Moist hedges.

Conium maculatum. Hedges.

Chærophyllum sylvestre. Pastures.

* **Smyrnium Olusatrum.** Hedges near Avon side, formerly cultivated, but its place now supplied by Celery.

* **Viscum.** On fruit trees ; a bad orchard weed.

* **Galium Mollugo.** Hedges.

G. verum. In pastures.

† **G. spurium.** Corn galium or hairough. Cornfields.

Possibly an error for G. tricorne.

Valeriana dioica. In moist meadows, hedge sides, &c.

V. officinalis. In moist meadows, hedge sides, &c.

Dipsacus sylvestris. Moist hedges.

* **D. pilosus.** Moist hedge sides near Droitwich.

Scabiosa succisa. Rough pastures.

Tragopogon pratensis. Vale of Severn.

Cichorium Intybus. At Pinvin, north of Pershore. Introduced into cultivation by Mr. Arthur Young.

Tanacetum vulgare. Abundant near the Stour and other rivers.

† **Senecio paludosus.** Bird's tongue groundsel. Near Malvern Well by the road side and on the road thence to Upton.

An incredible record.

Inula dysenterica. Road side, on moist ground ; common.

Chrysanthemum segetum. Cultivated ground.

Matricaria Parthenium. Hedge sides, Shrawley.

† **Anthemis arvensis.** Corn chamomile. A common corn weed.

The plant probably intended is Matricaria inodora. A. arvensis is very local.

Convolvulus arvensis. Corn fields.

Convolvulus sepium. In hedges.

Solanum Dulcamara. Hedges.

S. nigrum. Road sides and on dung hills in most parts of the County.

Hyoscyamus niger. Road sides and amongst rubbish.

Verbascum Thapsus. Road side on sandy ground north of Kidderminster.

* † **V. Blattaria.** In the same situations with the last.

I suspect an error.

Scrophularia aquatica. Watery places.

Antirrhinum Linaria. In hedges.

Euphrasias, two sorts. Corn fields and pastures.

These may be accepted as records for E. officinalis, L., and E. Odontites, L. The latter is noted in a previous List.

Veronica hederifolia. Amongst wheat very early in the Spring.

V. serpyllifolia. Hedges in Summer.

V. Chamædrys. Hedges in Summer.

V. Beccabunga. In shallow streams.

Verbena officinalis. Road side, Powick ; amongst rubbish in the town of Evesham in great profusion.

Mentha arvensis. Corn fields and moist ground.

Glechoma hederacea. Hedge banks.

Scutellaria galericulata. Side of the canal between Wolverley and Stourport, in many places.

Marrubium vulgare. Road sides, on sandy and gravelly soils at Shrawley.

Ballota nigra. Hedges in the Vale of Evesham. Marshall.

Teucrium Scorodonia. On hedge banks.

Echium vulgare. Road side in the north of the County.

Symphytum officinale. In great plenty upon the Stour near Kidderminster.

Cynoglossum officinale. Hedge sides, Shrawley, and other places, in the town of Evesham on rubbish.

Primula vulgaris. Ditch banks.

P. veris. Meadows.

Plantago major. Road sides.

P. lanceolata. In pastures

Chenopodium Bonus-Henricus. Banks on road side near Bromsgrove.

C. rubrum. Road sides.

Atriplex patula. Road sides and on rubbish.

Euphorbia amygdaloides. Hedges near Worcester, on the Bewdley Road.

Mercurialis perennis. In hedges between Bromsgrove and Fockbury.

Juniperus communis. On barren waste land between Evesham and Church Lench.

Arum maculatum. On ditch banks. Common.

Tamus communis. Hedges in the Vale of Evesham.

Allium vineale. Vale of Severn. Marshall.

Avena fatua. In hard tilled corn fields.

Hordeum murinum. Dry banks on road sides.

Equisetum arvense. In corn fields.

E. palustre. In bogs.

If, from the 90 plants in the above list, we deduct 14 for repetitions of previous records and for obvious errors, we have remaining 76 species to be placed to Mr. Pitt's credit on account of the Worcester census.

(To be continued.)

THE MIDDLE LIAS OF NORTHAMPTONSHIRE.

BY BEEBY THOMPSON, F.G.S., F.C.S.

(Continued from page 179.)

The following proofs of the free circulation of water, and, consequently, the continuity and capacity to receive and store water, refer particularly to the Rock-bed:—

1.—All the water which is found in the Middle Lias, whether at Northampton or elsewhere, must have got in from the surface somewhere, and since the water in the Billing Road Well at one time rose 90 feet above the water-bearing rock, it is clear that the catchment area must have been *more* than that height above the rock which supplied the water, and so some considerable distance away.

2.—It is no local condition of the Marlstone to be porous, and to yield water. In Northampton itself, at least five wells have been made reaching to the Marlstone and yielding water. Two were made by the Waterworks Company—one at their chief pumping station, and the other near their reservoir; one at the County Jail; a fourth at Messrs. Brettell's Foundry; and a fifth at the Barracks. Besides these, in the districts west and south-west of Northampton there are probably some hundreds of such wells; there may be ten or twelve in a moderately-sized village where the Marlstone is not deep.

3.—Northampton has been taking more than its share of the Middle Lias water; hence, many of the near wells, not quite so deep, have ceased to yield water. This is the case with three out of the five wells mentioned above as formerly existing in Northampton. I believe, too, that without exception the water level in the Marlstone wells of the county has been gradually sinking—an absolute proof of the general continuity and porous nature of the bed.

4.—I believe it is rare for a single well in any formation to yield more than 1,000,000 gallons per day, unless aided by headings, or supplied by more than one spring. Without these aids the Middle Lias at both Northampton and Kingsthorpe has yielded water at the rate of 800,000 gallons per day, an amount, it will be seen, approximating to the maximum supposed to be obtainable from a single well. Such being the case, and bearing in mind the distance away of the Middle Lias catchment area, it must be pretty evident that some of the nearer dumb-wells would be able to impound something like 1,000,000 gallons per day, supposing that amount of water to be available, and the head of water at the pumping station to be kept low. Direct experiment confirms this.

5.—It is extremely improbable that definite underground channels for water primarily exist in porous beds like the Marlstone, or the sinking for water would be a very precarious operation; yet, in the neighbourhood of springs and wells such channels are gradually developed, because water will flow most freely in the direction of least resistance, and in doing so will gradually reduce that resistance if there is anything capable of being dissolved by water.

A rock which is continuously used as a water-bearing one gets more porous, for all the water which comes from such a bed is charged with mineral matter dissolved out of it. As an instance, our Marlstone water contains rather more than 50 grains of solid matter to the gallon. Supposing that for thirty years an average of 500,000 gallons per day has been pumped, this would give a total of over 17,456 tons of solid matter removed. The rock-bed has a specific gravity varying from 2·5 to 2·8, say 2·7 on the average, then 17,456 tons of it would occupy a space of nearly 232,000 cubic feet, and the matter actually dissolved probably more than this amount, because of a lower average specific gravity. After making large allowances for solid matter derived from superficial sources—soil or gravel—and possible shrinkage of the bed, it must be evident that it is made more porous by use. Wells do often improve considerably with use.

It may be demonstrated that water flows from one point to another in a saturated porous bed with a head due to the difference of vertical level of area of outcrop to that of area of discharge, less the frictional resistance; also that increase in the carrying power of a bed is almost in direct proportion to the water pressure.*

Through the kindness of Sir George Bannerman, Bart., I am able to offer some direct evidence of the porosity of the Marlstone in the neighbourhood of Brackley. Brackley Town Well was commenced in 1874 under the advice of my late friend Mr. S. Sharp, F.G.S., F.S.A., and reached a depth of 177 feet 6 inches.† The water then rested at 100 feet from the surface; that is, there was a head of water of 77 feet 6 inches. In 1882 this head was reduced to 41 feet; May, 1884, to 39 feet 6 inches; September 17th, 1884, to 36 feet 6 inches. When this last depth was taken the pump had been stopped from Saturday at noon to Monday afternoon, so that the natural water level might be ascertained. The pump used at Brackley discharges 6,000 gallons per hour, and after six hours' continuous pumping, on September 17th, the water level was reduced 11 feet 6 inches, leaving 25 feet in the well, and below this the pump could not bring it. In a few hours after the pumping was stopped, the water stood at the same level as before it was commenced, rising 2 feet in the first fifteen minutes. Here an increase of the difference between the water level inside the well and in the bed, of $11\frac{1}{2}$ feet, produced a flow of water of 6,000 gallons per hour, or 144,000 gallons per day. A simple

* Mr. De Rance quotes some experiments made with New Red Sandstone blocks, which gave the following results:—With a pressure of 10lbs. to the square inch, $4\frac{1}{2}$ gallons of water passed; with 20lbs., $7\frac{1}{2}$ gallons; and with 46lbs., 19 gallons.

† I may say that the depth of well and height of water at first were originally given to me by Mr. Sharp, and differ a little from those afterwards given me by Sir Geo. Bannerman, and quoted above.

calculation based on the assumption before referred to, that flow of water is nearly proportional to the pressure, shows that a head of 100 feet acting through the same amount of rock would yield upwards of 1,250,000 gallons per day. If instead of reducing the water level in the well by $11\frac{1}{2}$ feet, the head of water in the bed had been increased by a like amount, a yield of water only a little less than that actually obtained would have resulted, the reduction being due to the increased amount of rock through which the water pressure would be exerted. The receptive capabilities of such a well might fairly be put down at about 1,000,000 gallons per day, if the water could be put into it fast enough to maintain a head of 100 feet above the rest-level, a result agreeing with that arrived at in another way.

(To be continued.)

NOTES ON A ROCK FROM NEW ZEALAND, AND ON THE DUST EJECTED IN THE ERUPTION OF TARAWERA, IN JUNE, 1886.*

BY THOS. H. WALLER, B.A., B.SC.

The specimen which forms the subject of the following description was collected by my friend, John H. Lloyd, Esq., some three years ago, at Wairoa, on Lake Tarawera. On his return to this country he very kindly gave me a slice from it, but I found that it was so full of cracks, and, therefore, so readily disintegrated that I put it aside despairing of making a successful section. When, however, in June of this year the great volcanic eruption occurred in New Zealand, and buried in the ejected ashes and mud the village of Wairoa, the interest added to the specimen mentioned induced me to make an attempt to grind it thin.

Thanks to some practice which I had lately had with vesicular and friable rocks I was able to obtain a fair section.

The specimen is a grey glassy rock with very numerous cracks. It shows also many crystals and spherulites, many of the latter being hollow. On microscopic examination the ground mass is found to be perfectly glassy but to contain a very large number of minute crystals of a pale green or greenish yellow colour. They are about four to six times as long as they are thick and a good proportion of them are

* Transactions of the Birmingham Natural History and Microscopical Society, Geological Section, October 26th, 1886.

slightly thicker at the ends. They evidence by the positions in which they lie in the rock the motion which was taking place in the mass after they separated out. They form bands and streams heaped up where they encounter a larger crystal and are occasionally perfectly irregular in their distribution.

In addition to these microliths there are minute roundish bodies which in many cases seem to be the transverse sections of the first named bodies, but in others they appear as if they were strung together on a fine string forming the so-called Margarites. These are frequently of considerable length and are curved in various directions through the section.

The mineral nature of these minute bodies is very uncertain; they do not appear to show any definite crystal shape, and the points of the longer microliths show no signs of planes. They are not doubly refracting but remain quite dark between crossed Nicols.

In many places several strings of minute granules are attached at one end to an opaque grain, probably of magnetite.

The spherulites are mostly hollow, and though probably this is due in a few cases to the central parts having broken out in grinding, a good many are apparently hollow in the rock itself. They are rather imperfectly seen in my section, as this is somewhat thick, but appear to be composed of threads of doubly refracting substance roughly radial in position, but not so regularly as to show any black cross between crossed Nicols. The polarisation is irregular and not very marked.

The spherules are in many cases surrounded by a clear yellow margin, which, however, is seen, when a high power is used, to be fibrous and doubly refracting in character, and to be the ground, so to speak, in which the more opaque elements of the spherulite are imbedded. The microliths of the glassy base seem in some cases to be visible within the spherule, but in other cases they appear heaped up on its outer edge as if they had been driven against it by the flow of the lava.

The larger crystals which occur porphyritically are felspar, hornblende, and the strongly dichroic rhombic pyroxene which is usually called hypersthene.

The hornblende occurs sparingly and is of the normal olive brown colour. The crystalline fragments occasionally show the cross section of the prism, with the cleavage traces intersecting at the usual angle. The long and narrow sections extinguish at varying angles with the cleavage traces.

The rhombic pyroxene also occurs only sparingly. It is distinguished at once from the hornblende by its extinguishing when the traces of the prismatic cleavage in approximately longitudinal section are parallel to the axes of the Nicols, by the nearly right-angled prism which is shown by the cleavage in cross sections, and by the different dichroism, the colour of the vertical sections varying from a reddish brown to green during a rotation when the polarising prism only is used.

The felspar is both orthoclase and plagioclase, but I have not been able to determine the exact character of the latter. The chief point of interest is that the crystals are frequently mere skeletons of felspar substance enclosing a perfect swarm of glass inclusions. These are of most irregular shapes, sometimes very large at other times of but small size. They almost always appear slightly brownish in colour and with but few exceptions are provided with a spherical cavity.

Seeing that these cavities obviously vary a good deal in the proportion they bear to the size of the inclusions which contain them, it seems reasonable to conclude that they are at any rate in part air bubbles, and it is quite possible that their presence may have determined the formation of the inclusions. As is so usual, it is frequently noticed that the outer zone of one of a felspar crystal is much more clear and continuous than the central parts, as if the crystallisation went on more quietly and regularly towards the end of the cooling process.

A few instances of strain polarisation may be observed in the glassy base, and occasionally cracks closely surround crystals of the rhombic pyroxene, but the phenomenon is not very striking.

As all present will no doubt remember the terrific explosive eruption of Mount Tarawera, last June, I need not spend much time on a description of the damage done by it.

It may be interesting, however, to note that the usual linear character of the volcanic action was well shown. If a map of the volcanic region of the North Island is consulted and a line drawn from Mount Tongariro, in the S.W., to White Island, in the Bay of Plenty—both of them active volcanoes in a small measure—there will be found lying on it both Mount Tarawera and Lake Rotomahana, into which the lovely white and pink terraces, the result of the deposition of silica from boiling springs on the hillside, descended.

These, alas, have been utterly destroyed. The hot springs were evidences of a weak place, and when the explosion occurred it was among those which gave way.

Mount Tarawera is described by travellers as presenting the appearance of a glassy dome, no doubt a rock such as that just described and the mountain was one of the most strictly tabooed of all the district, for on its summit were exposed the bodies of the chief men of one of the most powerful of the tribes. It had been their cemetery for the whole of their traditional history, and it is certain that it had never been in eruption since the Maoris entered New Zealand. Whether this furious outburst has exhausted the forces below, or whether, as in the case of Vesuvius, in 79 A.D., it is but the re-establishment of an active crater, must be left for the future to determine. The celebrated Dr. Hochstetter, who made a geological survey of New Zealand in 1859, expressed his opinion that the whole country was so completely undermined by the decomposing and removing action of the hot springs, that eventually an explosion would occur by the falling in of the crust. It is probable that something of this sort happened. So far as any accounts which I have seen relate, there was no flow of any lava. Showers of stones and mud have done the damage, and dust has been so distributed over the district as to completely cover the vegetation and in many places destroy even the trees.

A microscopical examination of a specimen of the dust collected on the steamer "Southern Cross," in the Bay of Plenty, which has been placed at my disposal by my friend, J. E. Clark, B.A., of York, shows the same relation of things. There are very few portions which can be referred to the ejection of a fluid lava, and probably these are really fragments of a pumice which has been shattered by the explosion. There are glass fragments of all degrees of porosity —in some the pores are approximately spherical, while others again are drawn out into mere threads and twisted about most confusedly. Other pieces of glass contain microliths similar to those previously mentioned as occurring in the Tarawera obsidian, and also the globulites, both singly and in strings. The felspar is mostly orthoclase, but one cleavage fragment which is well twinned gives the extinction of oligoclase. This fragment also contains some inclusions of a brownish glass, which have apparently the same crystalline shape as the enclosing crystals—so-called negative crystals. I have found no hornblende, but there are a few grains of the rhombic pyroxene, with strong dichroism.

There are also a number of fragments of a lightest brown almost opaque substance, which when quite thin can be examined in polarised light and shows a doubly refracting composition, but very indefinite and confused. It has some similarity with the spherulites before mentioned, but occurs in too great quantity for this explanation to be probable.

On the whole it is evident that a solid rock, which, however, varied from a pumice to such an obsidian as we have considered in the early portion of this paper, has been blown into small fragments by the explosion.

Unfortunately my specimen was far too small to permit of an analysis, and I have not seen any in the New Zealand papers which have reached me.*

It may be worth while to mention that at the time of the disturbance Tongariro became somewhat explosive, and even the snow-clad Ruapehu began to emit smoke. At the other end of the line of fissure White Island had been unusually active for some time. It is worked for sulphur, and the workmen had been unable to get to it on account of increased violence in its eruptions. Since June it has been in eruption to an extent sufficient to be reported in the English papers.

As the country all round Auckland is volcanic and many of the hills are craters—Mount Eden, for instance, which closely overlooks the city and forms, in fact, a suburb of it—there has naturally been some anxiety felt as to the probability of another outbreak of these hills. This set of volcanoes, however, is much older than the Taupo series—indeed, we may consider it likely that the latter replace the former as safety valves. The fissure has opened in a slightly different position, as is not unfrequent.

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* Since this note was communicated to the Society I have been able, through the kindness of Mr. W. J. Harrison, F.G.S., to make an analysis of another specimen of the dust, with the following result:—

	I.	II.
Silica	61·9	58·07
Titanic acid	1·0	
Alumina	12·9	13·22
Ferrous oxide	3·8	10·10
Ferric oxide	2·8	
Lime	7·1	7·04
Magnesia..	2·7	4·46
Potash	2·0	1·58
Soda	3·8	2·59
Loss on ignition.. ..	2·2	1·50
	100·2	98·56

In column II. I have copied for purposes of comparison an analysis of the Armathwaite dyke as given by Mr. Teall in his paper on "Some North of England Dykes," Q.J.G.S. for May, 1884, p. 224, from which it will be seen that the principal difference consists in the much larger proportion of iron present in the English rock from which the darker character and more basaltic look follow.

THE PRINCIPLES OF BIOLOGY.

BY HERBERT SPENCER.

PART V.—PHYSIOLOGICAL DEVELOPMENT. CHAPTERS VI. TO X.

These were expounded by Professor Haycraft, F.R.S.E., then Professor of Physiology at the Mason College. The Professor gave a detailed explanation of the course of the Physiological Development of Animals, as narrated by Mr. Herbert Spencer, and increased the interest of the narrative by many apt and striking illustrations.

PART VI.—THE LAWS OF MULTIPLICATION. CHAPTERS I. TO VIII.

BY W. B. GROVE, B.A.

"If organisms have been evolved, their respective powers of multiplication must have been determined by natural causes." The adaptation of the reproductive activity of an organism to its conditions of existence has been determined by the same means—the action and reaction between it and its environment—by which its other adaptations have been effected.

We speak here only of organisms which maintain their ground. Those species which are dying out are excluded from the present argument. If a species is flourishing, it is so because of a certain relation established between the forces which tend to preserve it and the forces which tend to destroy it; and Mr. Spencer's enquiry is directed to the purpose of ascertaining if this relation is capable of being expressed in a definite numerical form—as indeed the laws of *multiplication* should be.

If the forces destructive of race, when once in excess, had nothing to prevent them from remaining in excess, the race would disappear; and if the forces preservative of race, when once in excess, had nothing to prevent them from remaining in excess, the race would go on increasing to infinity. There must be some way by which the excess of either of the conflicting forces is automatically adjusted; for the only alternative is to call in that perpetual meddling with the world on the part of its Creator which the older theologies postulated, but which hardly anyone would now seriously maintain.

There must thus be here, as wherever antagonistic forces are in action in the world, a rhythmic movement, an alternate predominance of each, and each by its very excess must call into play certain counter forces which eventually out-balance it and initiate a movement in the opposite direction. The dangers* which a species has to combat, and its ability to combat them, must each on the average remain at a constant level.

If the reproduction of a Hydra be imagined to proceed as slowly as that of Man, the race would immediately die out. On the other hand, did Oxen propagate as fast as Infusoria, they would all die of starvation in a week. As the ability of a species to meet the forces which tend to destruction is a constant quantity, and this comprises two factors—power to maintain individual life, and power to multiply—these must vary inversely as one another; one must increase as the other decreases. In other words, as high organisation implies great capacity for self-preservation, a correspondingly low degree of fertility will suffice to maintain the numbers; and in a lowly organised creature, whose power to contend against the adverse forces of the environment is small, great fertility must exist to compensate for the increased mortality.

But not only is this so: it is possible to see why it is so. Each organism having, on the average, a fixed power of obtaining nutriment—that is, of acquiring energy; the more it uses up this stock of energy for its own processes of life, the less will it have to spare for producing new individuals. For, as has been shown in previous chapters, Genesis, by whatever mode it may be carried on, is a process of disintegration, and is thereby essentially opposed to that integration which is one of the elements of Evolution. The other element, differentiation—or the division of labour between the parts of an organism—implies a transfer and transformation of food which also requires the expenditure of energy. Both elements tend to prolong the individual life, but only at the cost of the store of energy which can be reserved for Genesis. Individuation, therefore, and Genesis must necessarily vary in an inverse ratio—*i.e.*, $I \propto \frac{1}{G}$ or $IG = \text{constant}$.

This relation, however, though nearly true, is not exactly so. Each advance in Evolution implies economy, and thus the product of I and G, instead of remaining exactly constant, increases slightly with each advance in organisation, and this surplus becomes an admirable self-acting tendency to further the supremacy of the most developed types.

* Under this head natural death is included, for this only differs from what is called accidental death in the *smallness* of the cause which proximately induces the effect. I may note that I have, as far as possible, used Mr. Spencer's own words in stating his opinions.

The remaining chapters contain a summary of the evidence with which the detailed study of nature supplies us, in proof that the result which we have thus theoretically arrived at is that which actually exists. Allowing for the difficulties of inductive verification, which are many, the evidence adduced shows that not only is the antagonism between Individuation and Genesis true (as it obviously is) in the gross, and when comparison is made between organisms so unlike as Infusoria and Man, but it is also in most cases true in detail, between organisms closely allied, and from every conceivable point of view. For this evidence, however, reference must be made to the original, in Chapters V. to VIII. For the strength of such an induction depends upon the collective instances, and cannot be still further summarised without losing all its force.

Wayside Notes.

At the Meeting of the Midland Union of Natural History Societies at Malvern someone clearly blundered, and the blunder went a long way towards spoiling what might have been one of the most successful, as it was one of the most enjoyable, of these annual meetings. Everyone sympathised with the President, the Rev. G. E. Mackie, in the discouraging part he had to play, and admired the brave way in which he bore his load of anxiety. He even plucked up courage enough in his address to venture upon a few jokes, one of which is too good to let pass, as probably it will not be embalmed in the "Presidential Address." It was the answer of a boy, presumably at the College, to the question: "What do you know about Titus?" "Titus was a man in the Bible," penned this ingenious youth. "He wrote a book. His other name was Oates!"

It was a happy thought to give up a Conversazione, which was unprepared for and bound to fail, in favour of an open-air drive round the northern hills. The evening was delightful, and the ride was a most enjoyable departure from an impossible programme.

Not the least interesting feature of the drive was a well at North Malvern, which is being sunk by a poor fellow on a small piece of land he has bought for the purpose of erecting a cottage. Within a very short distance his neighbours have water within twenty feet or thereabouts of the surface. This well has been sunk through sixty-seven feet of strata, a description of which will be found upon another page, while the boring has proceeded twenty-two feet further, but no water has been found. The breccia is a really remarkable rock, and requires considerable study. The whole section is deeply interesting to the students of local geology, but it means ruin to the unfortunate cottager.

The Meeting at Northampton next year will be looked forward to with no little pleasure by the old stagers of the Union, who remember with much relish the capital meeting there in 1880. That meeting will take a great deal of beating, but the local Secretary says they mean to try.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—MICROSCOPICAL SECTION, July 5. Mr. W. B. Grove, B.A., in the chair. Mr. W. Madeley exhibited a specimen of British sponge, probably *Chalina oculata* (Bowerbank), from Colwyn Bay; Mr. W. B. Grove, B.A., exhibited *Barbarea stricta* and *Alopecurus bulbosus*, two rather rare plants, from Clifton Ings, Yorkshire; Mr. W. H. Wilkinson, specimens of small spiral snail shells (*Clausilia nigricans*, var. *dubia*), from a stone wall in Scotland; also, *Salix fragilis* (Lin.), a willow, often called the "Cotton" tree, the seeds of which, last month, caused a shower of down through the streets of Staines, on the Thames; also a collection of interesting plants from Clent, amongst which were the following: *Viburnum opulus*, *Tragopogon pratensis*, *Genista tinctoria*, and *Briza media*.—BIOLOGICAL SECTION, July 12th. Mr. Horace Pearce, F.L.S., F.G.S., exhibited a collection of freshly-cut specimens from his British wild-flower garden. For some years Mr. Pearce has grown native wild flowers in a portion of his garden set apart for their special cultivation, and by supplying, as far as possible, the conditions essential to the healthy growth of the various plants, he has succeeded in getting together a good collection of many of our choice and rare native plants. He has maritime plants from our coasts, limestone-loving plants, and others from Alpine and rocky situations, and some requiring shade and shelter; all these conditions he seeks to supply, and a large share of success has rewarded his efforts, with both ferns and flowering plants. The following were the plants exhibited and described:—

Viola lutea, var. amœna	from	St. John's Vale, Keswick.
Silene maritima	,,	Pwllheli.
Carduus eriophorus......	,,	Abberley, Worcestershire.
Geranium sanguineum ..	,,	Great Orme's Head.
,, sylvaticum....	,,	Thirlspot, Keswick.
,, pratense	,,	Castleton, Derbyshire.
,, pyrenaicum ..	,,	Wrockwardine, Shropshire.
,, lucidum	,,	Chepstow.
Erodium maritimum	,,	Habberley Valley, Kidderminster.
Genista tinctoria........	,,	Near Enville.
Agrimonia Eupatoria....	,,	Ludlow.
Sedum Rhodiola	,,	Snowdon.
Campanula Trachelium..	,,	Milson, Shropshire.
Armeria vulgaris	,,	Pwllheli.
Echium vulgare	,,	Kinver Edge.
Verbascum Lychnitis....	,,	Whittington, Staffordshire.
Asplenium viride........	,,	Mountain, near Mardale, Cumberland.
Aspidium Lonchitis	,,	Snowdon.
Polypodium Robertianum	,,	Miller's Dale, Derbyshire.
Osmunda regalis	,,	Mountains east of Harlech.

Mr. W. H. Wilkinson exhibited the following lichens collected by Mr. W. B. Grove, B.A., in the neighbourhood of Barmouth:—*Usnea barbata*, *Ramalina fraxinea*, *Peltigera canina*, *Parmelia saxatilis*, *Stereocaulon denudatum*, *Stictina fuliginosa*, *Lecanora subfusca*, *Ramalina farinacea*, *Ramalina fastigiata*, *Peltigera rufescens*, *Parmelia perlata*, *Sphærophoron coralloides*, *Cladonia cervicornis*, and *Lecidea disciformis*.—GEOLOGICAL SECTION MEETING, Tuesday, July 19. Mr. Waller in the chair. Mr. Caswell exhibited a specimen of cabbage leaf in which the midrib, having left the surface of the leaf, had developed a cup upon a stalk. Mr. Grove exhibited two specimens, *Ornithopus perpusillus*, from the Lickey, and a fungus, *Polyporus dryadeus*, from Kingswood.

Mr. Bolton exhibited *Anuræa serrulata*, a rotifer, from a pool within the borough. Mr. Marshall exhibited specimens of plants from the island of Skye, including *Drosera anglica* and *Sedum Rhodiola*; also. geological specimens of rocks from the Black Cuillins and the Red Cuillins of Skye. Mr. Waller gave some interesting particulars of the remarkable and unique geology of Skye and the surrounding district. —Sociological Section, July 26. The President, Mr. W. R. Hughes, in the chair. Mr. W. H. Wilkinson exhibited *Pimpinella magna*, *Carex remota*, and the following lichens, all from Hartshill:—*Physcia parietina* and *Lecidea canescens*. Mr. T. Bolton exhibited a fine display of rotifers from a pool near Hartshill Castle, including the rare one, *Asplanchna intermedia*, male and female; also *Brachionus amphiceros*, *B angularis*, *Polyarthra platyptera*, *Triarthra mystacina*, and *Anuræa brevispina*. The President read a series of letters relating to the work of the Section, and the Hon. Secretary reported that the excursion to Hartshill on the previous Saturday had passed off very pleasantly.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—Sociological Section.—The ninth excursion of the Section was made on Saturday, July 23rd, to Hartshill, near Atherstone, the country of Michael Drayton, by a party numbering twenty-nine members and friends. The remains of Hartshill Castle were visited, and the house in which Drayton is said to have lived. In this and some of the neighbouring cottages the manufacture of silk ribbons in homely wooden machines, cleverly actuated by hand and foot, excited much interest among the visitors. By the kindness of the Vicar and other governors tea was served in the Hartshill Schools, the President of the Section, Mr. W. R. Hughes, F.L.S., presiding. After tea Dr. Showell Rogers, M.A., read a characteristically interesting paper on "Michael Drayton," and exhibited Dr. Johnson's copy of Drayton's poems, now the property of Mr. Sam Timmins. The arrangements for the excursion were made by Mr. F. J. Cullis, F.G.S., the Hon. Secretary of the Section, and the enjoyable character of the excursions of the Sociological Section was well maintained through the afternoon.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY. —Section D. Last month four of the members visited Stonesby and Saltby, which are situated on the strip of oolitic rock which occupies the north-eastern edge of the county. The following rare plants were collected near Saltby, of which the first two are new to the county:— *Senecio campestris*, *Hippocrepis comosa*, *Cerastium arvense*, *Astragalus hypoglottis*. On the 13th of July four members made an excursion to Glen, and thence through Wiston Park. No very rare plants were met with, but some *Conium maculatum* and good specimens of *Acorus Calamus* were found. On July 20th the ordinary monthly meeting of the section was held, when the above plants were shown, and also several others by the Rev. Mr. Preston, amongst the latter being an unusually fine example of *Carduus tuberosus*. A short discussion took place on the best methods of teaching elementary science in public schools, with special reference to natural history studies. A paper was read by the chairman (Dr. Hy. Tomkins) on "The Active Principles of some British Poisonous Plants." Various specimens of these were shown in the fresh state, and the alkaloids and other active principles from them were exhibited, with a brief account of the various parts of the plants in which these were found. Their properties and physiological action were also referred to.

Erratum.—No. 115 (July), page 192, line 13 from the top. *Ranunculus* "*parvus*" should be *parviflorus*, as it was described at the meeting (Dudley and Midland Geological and Scientific Society).

THE OCCURRENCE OF GOLD AT MOUNT MORGAN, QUEENSLAND.*

BY THOS. H. WALLER, B.A., B.SC.

A good deal has been heard of Mount Morgan during the last year or two, its name having been used to recommend to the attention of investors mines in the same neighbourhood which, nevertheless, may for all the English public can tell, be of a very different character, and in the course of the prospectuses some information has been given as to the mine itself. Still, I suppose the normal fate of such documents is the waste-paper basket, and the facts respecting this unique gold occurrence are so remarkable that they seemed worthy of a short note.

Those who visited the Colonial Exhibition last year will remember, possibly, the great masses of red-brown stone, piled up in the centre of the Queensland Court, looking like portions of great stalactites of hematite. The specimens I am able to show you to-night were sent to me by my brother, who obtained them when visiting Queensland on business a couple of years ago, and they show the same structure of the material.

The history of the mine is as extraordinary as its chemical and geological relations, and affords a striking instance of the value of observation when united to knowledge, and above all of the value of keeping your own counsel until you can see your way to turning knowledge to your own advantage.

About 1870 a squatter took up a couple of "selections" of land of a square mile each, about twenty-five miles (southwest) from Rockhampton, in Queensland. One of these included the south-east portion of a rough and rocky hill, which here and there showed among its stunted vegetation great boulders of a dark metallic looking-rock. Farming did not prosper with the unfortunate possessor of the land, and when copper mining seemed likely to succeed in the district, he had his selection examined by a professional geologist, who found no copper, but pronounced the rough hill a mountain of ironstone. Droughts, the frequently recurring curse of Australia, and other causes, finally ruined the squatter, and he had to take to labourer's work in a mine near by. One day, he offered to show his mountain of ironstone to the owners

* Transactions of the Birmingham Natural History and Microscopical Society. Geological Section. Read April 19th, 1887.

of the mine in which he was working, and was much surprised at receiving shortly afterwards £1 per acre for his selection, £640 in all. This took place in 1883, and in 1885 a tenth share was sold for £31,000, while the unfortunate original owner was employed as ostler at a wayside inn on the way to Rockhampton.

The hill itself is 1,225 feet above the sea, and the actual height of the summit above the level of the river bed at its foot is 521 feet. The manner of working is simply that of quarrying off the crown of the hill to a depth of about eighty feet, while a second quarry, 250 feet lower down, is cut in a different sort of deposit, which, however, is also richly auriferous. The upper part of the hill is composed of the dark rock previously mentioned, while lower down the mass is white and as porous as pumice stone; indeed, it was sold in Rockhampton for scouring doorsteps and hearths. Intermixed with this white porous stuff are masses of brilliant colours, crimson, violet, green, and in the cavities, or sometimes little caves, which are met with in the workings, stalactites and stalagmites are met with, only siliceous instead of composed of calcite, like those with which we are familiar. It is stated that some of the cavities, although quite free from stalactites, have yet the stalagmite bosses on the floor.

According to Mr. R. L. Jack, the Government Geologist, the "country rock" in the immediate vicinity of Mount Morgan consists of a quartzite full of minute crystals of iron pyrites, various ashy and siliceous rocks, shales apparently hardened by heat, and a few belts of serpentine. Cutting through these rocks are numerous dykes of rhyolite, and of a diabase in an advanced state of alteration. There are also quartz reefs which contain a fair amount of gold.

He says further:—"After a careful study of the whole formation, I have come to the conclusion that nothing but a thermal spring in the open air could have deposited the material under consideration. The frothy siliceous sinter agrees in every respect with the deposits of New Zealand and Iceland geysers, and of the still more wonderful hot springs of the Yellowstone National Park. The frothy or cavernous condition of the siliceous sinter of Mount Morgan may be accounted for by the escape of steam, while the silica was yet (after deposition on the evaporation of the water) in the gelatinous condition so frequently observed in the deposits of hot springs." Further: "The gold and, to some extent, iron may have been dissolved out of the iron pyrites of 'some of the reefs of the district,' the gold possibly by chlorine, produced by the contact of hydrochloric acid derived from the decomposition of chlorides with manganese, which occurs sparingly in the form of pyrolusite along with the ironstone of Mount Morgan."

In Mr. Jack's opinion, the great geyser which has built up Mount Morgan was of Tertiary age, and broke through the sandstone, which has been traced over a very large area in Northern Queensland, and was named by the late Mr. Daintree the Desert Sandstone, and believed to be post cretaceous. In many places the valleys eroded out of this sandstone became the seats of volcanic action, the volcanoes breaking out in the upper parts of the valleys and filling the lower reaches with floods of basaltic lavas. The geyser would thus probably be contemporaneous, or nearly so, with the basalts, which have been the causes of the wealth of Victoria, by covering and so protecting from denudation so much of the old auriferous gravels.

The main deposit of gold is in the central core and the summit cap of the hill, probably the solid filling of the pipe and basin of the geyser; the siliceous sinter being much less rich, and some aluminous deposits, apparently similar to those of some of the mud volcanoes of the Yellowstone, being quite free from the precious metal.

The solution and deposition of gold in the manner here supposed is of very great theoretical interest. Given a chlorinated water, the solution of gold from previously existing reefs is of course easy, but since these, without doubt, owed their origin to the deposition of gold from the water which also deposited the quartz, we are not shut up to the explanation, and may, if we please, take it as only a special case of deposition from deep-seated springs.

The late J. A. Phillips described some years ago the numerous metallic deposits from a modern hot spring in California, and the very wide distribution of gold, though of course in very small quantities, has long been known. It has been proved to exist in sea water. Plates of copper exposed on a ship's side through a considerable length of time had gathered quite recognisable traces, and the processes of deposition from solution have been studied by Dr. Skey, of New Zealand, and the researches published in the "Chemical News" for 1874, Vol. XXX., pp. 151, 171.

In the character and distribution of the gold Mount Morgan is again extraordinary. It is the only known gold which is free from silver, and is also the purest known, as it assays up to 99·8 per cent., the $\frac{1}{500}$ part of impurity being copper, with a trace of iron. It is a curious circumstance that in Australia, with few exceptions, the purity of the gold seems to almost universally diminish from South to North, the average fineness of Victorian gold being given as 96 per cent., New South Wales 93, and Queensland 87. The purest Australian gold hitherto known is from Maryborough, in Victoria, assaying 99·3 per cent.

Another character of the Mount Morgan gold, and one by no means so satisfactory, is the extremely fine state of division in which it occurs, making the washing after crushing a very profligate process. The "tailings" which would in ordinary cases be thrown away are here said to retain half the gold, and are therefore stored for treatment by the process of dissolving by chlorine, and subsequent precipitation of the gold by sulphate of iron. Dr. Leibius, of the Sydney mint, experimenting on about 4cwt. of the crushed stone, could extract by amalgamation less than half of the gold present, and only a very small additional quantity was obtained by again milling with mercury.

There seems a considerable probability of other geysers having been in action at the same period in the same district, and indeed all over the Tertiary volcanic districts of Queensland, and of course the discovery of the riches of Mount Morgan has given an enormous impetus to prospecting in localities where the conditions seem at all similar; but then again the possibility, indeed probability, must be recognised that the occurrence of the gold in the old thermal spring was local, and that not every old geyser hill and basin is auriferous.

HISTORY OF THE COUNTY BOTANY OF WORCESTER.

BY WM. MATHEWS, M.A.

(Continued from page 204.)

The next writer to be mentioned is Thomas Purton (1768—1833), the author of the "*Midland Flora*," or "*Botanical Description of British Plants in the Midland Counties.*" The first two volumes of this work were published at Stratford-on-Avon in 1817, the third in London in 1821. Purton was a surgeon, residing at Alcester, a Warwickshire town on the eastern side of the Ridgeway, which divides the counties of Warwick and Worcester. It does not appear that, under the term "*Midland*," Purton restricted himself to any definite geographical area, as he notices plants from Warwick, Worcester. Stafford, Hereford, Salop, Derby, Gloucester, Oxford, and even Monmouth. His most numerous references are to the neighbourhood of Alcester, and of these it is not always easy to disentangle the Worcester records from those of Warwick. About midway between Alcester and Droitwich, in the county of Worcester, is the little village of Feckenham. There was formerly in this neighbourhood a large tract of forest, known as "Feckenham Forest." The only remnant of this in Purton's time was an extensive moor, about a mile south of the village, since drained and enclosed. Some of his most interesting records are of the plants of Feckenham Moor, of which all the characteristic ones are now extinct. Another locality frequently mentioned by Purton is Astwood Common, now enclosed, on the Worcester side of the Ridgeway south of Redditch.

Among Purton's correspondents were the Rev. W. S. Rufford, of Badsey, near Evesham, who furnished records of many plants from that part of Worcestershire, and William Scott, Esq., of Stourbridge, whose work, "*Stourbridge and its vicinity*," will be subsequently noticed in these pages.

Owing to the counties not being distinguished it is impossible to treat the notices of the commoner plants as Worcester records. The following lists include all the species assigned by Purton to the county, together with a few others :—

Purton, "*Midland Flora*," Vols. I. and II., 1817.

Fumaria *(Corydalis)* **lutea**, p. 327. Found by the Rev. W. S. Rufford on Broadway Hills, Gloucestershire.

Broadway Hill is in Worcester.

* **F. claviculata**, 327. At Malvern, upon the rocks above the village.

* **Cardamine impatiens**, 301. Side of Malvern Hill. Hanley Common.

* **Sisymbrium** *(Nasturtium)* **sylvestre**, 308. Badsey. Rufford.

Cheiranthus Cheiri, 311. The ruins of the Old Church and Abbey Walls of Evesham.

* **Turritis glabra**, 313. Sides of hedges, upon hedge banks in the lanes about Kidderminster and Stourbridge.

* **Drosera rotundifolia**, 166. Bog on Bromsgrove Lickey. West side of Malvern Hill.

Sagina *(Moenchia)* **erecta**, 104. Malvern Hill.

Cerastium arvense, 220. On Broadway Hills. Rufford.

* **Stellaria uliginosa**. Cookhill, on some boggy ground.

Spergula nodosa, 223. Hanley, near Malvern. Rufford.

Arenaria *(Spergularia)* **marina**, 216. Defford Common, between Pershore and Upton. Rufford. *Almost certainly S. neglecta, Syme. Lepigonum salinum, Kindb.*

Montia fontana, 91. Malvern. In a bog on the west side of the hill.

Linum Radiola, 165. Astwood Heath. *Radiola linoides, Gmel.*

L. usitatissimum, 164. Astwood.

* **Erodium moschatum**, 316. At Cookhill on the Ridgeway.

* **E. maritimum**, 317. About Stourbridge and Bewdley.

* **Geranium phæum**, 742. Abberley. Rev. Mr. Severn. Rufford.

G. lucidum, 320. In the lanes about Wolverley, and on the rocks at Great Malvern.

G. rotundifolium, 321. On a wall at Hartlebury.

* **Rhamnus catharticus**, 130. Harvington.

* **Genista anglica**, 333. In the neighbourhood of Stourbridge, Worc., but nearly extinct since enclosures have been general. Scott.

This I believe to be a Stafford record.

* **Anthyllis Vulneraria**, 332. Cleve.

Medicago sativa, 347. Lucerne. Cleve, Worc.

Melilotus officinalis, 346. Cleve, Worc.

Trifolium filiforme, 345. Astwood Common, &c., Worc. *It is doubtful whether this is T. filiforme or T. minus.*

* **T. arvense**, 345. In the neighbourhood of Worcester. Common.

T. fragiferum, 346. Cleve, Worc.

* **Astragalus glycyphyllus**, 348. Cleve Hill.

* **Vicia sylvatica**, 742. Woods near Clifton-on-Teme. Rufford.

Lathyrus Aphaca, 339. Cleve. Littleton.

Prunus insititia, 233. Bullace Plum. Badsey.

P. domestica, 234. Common Plum. Badsey.

* **Comarum palustre**, 248. Bromsgrove Lickey. About Stourbridge.

Lythrum hyssopifolium, 227. Badsey, near Evesham. Stubble-fields, Bretforton, Worc.

Peplis Portula, 181. At Cookhill, by the side of a pool.

Epilobium palustre, 190. Feckenham Bog.

Œnothera biennis, 195. In Worcestershire. Rev. Mr. Bourne. Withering. *No locality given. This is an American plant now widely distributed in England as a garden escape.*

Sedum dasyphyllum, 218. Badsey, near Evesham. Rufford.

* **Parnassia palustris**, 163. Bromsgrove Lickey.

Hydrocotyle vulgaris, 153. Feckenham Bog. Astwood Common.

* **Apium graveolens**, 158. On the canal beyond Droitwich. In a ditch at Upton Snodsbury. Bretforton, near Badsey.

* **Sison inundatum**, 152. In some springy boggy ground on Abberley Hills, above the Hundred House.

* **S.** *(Petroselinum)* **segetum**, 151. On a ditch bank supported by the hedge, between Hanbury and Droitwich. Badsey.

* **Pimpinella magna**, 157. On the side of the road between Droitwich and Ombersley, close to Sir John Packington's Park Wall.

Bupleurum rotundifolium, 148. Badsey, Bretforton.

* **Œnanthe pimpinelloides**, 149. In a ditch with Scirpus maritimus at Badsey.

* **Phellandrium aquaticum**, 156. Near Worcester. Rufford.

Caucalis *(Torilis)* **nodosa**, 146. Spechley and Badsey.

* **Smyrnium Olusatrum**, 159. In ditches about Badsey.

Galium uliginosum, 99. Feckenham Bog.

* **Scabiosa Columbaria**, 95. Mountainous and dry hilly pastures. Common. *No locality stated.*

* **Onopordum Acanthium**, 384. At Worcester, on the Evesham Road.

Carduus Marianus, 381. Near Worcester.

C. pratensis, 381. Feckenham Moors.

Carlina vulgaris, 386. Astwood Bank.

Anthemis arvensis, 398. On the Ridgeway, upon the new-made turf mounds, in great plenty.

A. nobilis, 398. Hanley Common and Malvern. Rufford.

Gnaphalium montanum, 390. *(Filago minima, Fries.)* On a common between Ombersley and Hartlebury, near the Mitre Oak. Malvern Hill.

* **G. rectum**, 391. *(G. sylvaticum, L.)* Ridgeway near Cookhill, Worc.

Senecio sylvaticus, 405. Astwood Common.

S. viscosus, 405. Badsey. Rufford.

* **Lactuca saligna**, 371. On a ditch bank by the road side at Spechley.

Jasione montana, 418. Burcot Lane, near Bromsgrove, and in other places about that neighbourhood.

* **Vaccinium Oxycoccus**, 196. Bromsgrove Lickey.

* **Erica Tetralix**, 192. Astwood.

Pyrola minor, 732. Abberley. Rev. Mr. Severn. Rufford.

* **Gentiana Amarella**, 138. Cleeve Hills, Broadway Hills.

Menyanthes trifoliata, 122. Bell's Mill, near Stourbridge. Scott.

Cuscuta europæa, 139. Badsey. S. Littleton.

* **Atropa Belladonna**, 128. Dudley Castle, 1815. Bufford. Bell's Mill, near Stourbridge. Scott.

Verbascum nigrum, 125. About Stourbridge, on the side of the Bromsgrove Road, &c.

* **V. virgatum**, 126. Discovered by the Rev. W. S. Rufford, in the neighbourhood of Worcester, where it was first found by Mr. Waldron Hill, of that place. I have since met with it on the side of the road from Worcester to Ombersley.

* **V. Blattaria**, 126. South Littleton, near Badsey. Common about Dunsley and Kinver, Staff. Scott. *I think Scott must have mistaken V. Lychnitis for V. Blattaria. It is the former species which grows about Dunsley and Kinver, as recorded by Stokes. Purton does not include V. Lychnitis in the "Midland Flora."*

* **Digitalis purpurea**, 294. Var. Flore albo. Near Bromsgrove.

Antirrhinum majus, 288. Littleton.

* **A. Linaria**, 286. *(Linaria vulgaris.)* Var. 2. **Peloria**. Badsey. Rufford.

A. Elatine, 287. *(Linaria Elatine.)* Cleve.

A. spurium, 287. *(Linaria spuria.)* Cleve and Littelton.

A. Cymbalaria, 288. *(Linaria Cymbalaria.)* Abbey walls, Great Malvern.

Limosella aquatica, 295. In ditches and roads about Badsey. Rufford.

† **Veronica triphyllos**, 53. Sandy fields. Not rare. *This must be an error. V. triphyllos is restricted to the Eastern Counties and Yorkshire.*

V. officinalis, 51. Astwood Bank.

Salvia Verbenaca, 57. By the side of the road at Harvington, leading to the mill.

Leonurus Cardiaca, 284. Near Malvern.

* **Pinguicula vulgaris**, 55. Upper side of Feckenham Bog. West side of Malvern Hill. *Extinct at Feckenham.*

Anagallis tenella, 115. Feckenham Bog. *Extinct at Feckenham.*

Plantago Coronopus, 92. On the side of the Bromsgrove Road, between Crab's Cross and Headley's Cross.

* **Rumex Hydrolapathum**, 185. In a wet ditch at Spechley.

* **Polygonum Bistorta**, 197. Near Bromsgrove, on the side of the Kidderminster Road.

Asarum europæum, 225. Very rare. *No locality given.*

Salix Lambertiana, 744. Badsey.

S. Helix, 471. Astwood.

* **Juniperus communis**, 482. Cleve Hill. Craycombe Hill.

Lemna trisulca, 436. Feckenham Moors. Cookhill.

Potamogeton lucens, 105. River Avon.

* **Zanichellia palustris**, 434. Feckenham Moors.

* **Triglochin palustre**, 188. Feckenham.

Sagittaria sagittifolia, 467. Harvington Mill.

Alisma ranunculoides, 189. In a ditch surrounding Feckenham Bog.

Orchis pyramidalis, 421. Cleve Hill.

O. *(Gymnadenia)* **conopsea**, 422. Cradley Park. Scott.

* **Ophrys apifera**, 426. Craycombe Hill, near Fladbury. Rufford.

* **Galanthus nivalis**, 170. On the side of the Ridgeway. *In which county is not stated.*

Narthecium Ossifragum, 172. Near Rubery Hill on the Lickey.

Juncus uliginosus, 177. Bromsgrove Lickey.

J. squarrosus, 176. Bromsgrove Lickey.

Cyperus *(Schœnus)* **nigricans**, 62. Feckenham Moors. *Extinct.*

Schœnus *(Cladium)* **Mariscus**, 61. Feckenham Bog. *Extinct.*

Scirpus cæspitosus, 64. Bromsgrove Lickey.

S. setaceus, 65. In a dry pool at Cookhill.

S. maritimus, 65. Marshes and ditches about Badsey. Rufford.

Carex dioica, 440. Bromsgrove Lickey. Rufford. *Extinct.*

* **C. pulicaris**, 440. Feckenham Bog. Bromsgrove Lickey.

C. stellulata, 441. Bromsgrove Lickey. Bog on the west side of Malvern Hill.

C. distans, 445. Feckenham Moors. *Extinct. It is possible that this may have been C. binervis. Sm.*

C. pillulifera, 448. Bromsgrove Lickey.

Agrostis pumila, 71. (*Var. of A. vulgaris.*) Astwood Common.

Arundo (*Calamagrostis*) **Epigejos**, 78. Not rare. *No locality stated.*

Aira (*Catabrosa*) **aquatica**, 74. About Stourbridge.

Festuca bromoides, 82. Astwood.

F. loliacea, 83. Badsey Fields. Rufford.

* **F.** (*Brachypodium*) **pinnatum**, 83. Badsey.

F. (*Brachypodium*) **sylvaticum**, 83. Cleve Hill.

Lolium arvense, 87. Fields about Badsey. Rare. *This is a variety of L. temulentum. L.*

Hordeum pratense, 88. Common. *No locality stated.*

Blechnum boreale, 517. In the lanes about Bromsgrove Lickey.

* **Asplenium Ruta-muraria**, 513. Badsey.

A. Trichomanes, 513. Badsey.

Scolopendrium Ceterach, 516. (*Ceterach officinarum.*) On walls at Badsey. Rufford.

Equisetum limosum, 501. Near Kidderminster.

* **E. palustre**, 501. Feckenham Bog.

Chara tomentosa, 435. Feckenham Bog.

C. flexilis, 435. In a stew at Cookhill.

The plants enumerated in the above list number ...		134
From which we must deduct—		
Species previously recorded ...	48	
Veronica triphyllos—an error (?) ...	1	
Asarum europæum, not specified as a Worcester plant	1—	50
Leaving for new records		84

(To be continued.)

ON THE MEASUREMENT OF THE MAGNIFYING POWER OF MICROSCOPE OBJECTIVES,

WITH EXHIBITION OF 1-25TH INCH WATER-IMMERSION OBJECTIVE OF POWELL AND LEALAND.*

BY WILLIAM P. MARSHALL, M.I.C.E.

This objective is of exceptionally high power, having a magnifying power of from 1500 to nearly 4000 diameters, according to the eyepiece used. The aperture of the objective is very small, and the face lens is not larger than a small pin's head, this lens having to be worked to as perfect a figure as the larger lenses. This objective requires delicate and careful handling, because of the extreme thinness to which the metal mounting of the face lens is reduced in order to allow of its being brought close enough to the object for bringing it into focus; and, in consequence even a slight touch upon the metal mounting of the face lens would be liable to cause serious injury.

The objective is not, however, difficult to use, and with suitable arrangements it is practically capable of being used as easily and expeditiously as one of low power; provided that the cover-glass of the object is of suitable thinness for focussing so high a power. This cover-glass is not required to be excessively thin in the present case (·005 inch is a suitable thickness), because the objective is a water-immersion lens, and, consequently, works with much greater clearance in proportion than a dry objective; and this 1-25th inch objective allows nearly as much clearance in working as a 1-8th dry objective. The special focussing arrangement used (the plan of Dr. Anthony) is a thin loose brass plate, laid upon the microscope stage under the object to be examined; this plate has a central aperture 7-8ths inch diameter, and projects 1-8th inch beyond the stage at the right-hand end, when it is pushed home to the stop at the left-hand end. The projecting top corner of the plate is touched lightly with the finger, and slightly lifted off the stage and lowered again continuously, during the course of bringing down the objective in focussing; and this gives instant warning of the approach to the object by momentary glimpses of the object being obtained in the lifting of the plate, enabling it to be promptly brought into focus. With this arrangement, so

* Transactions of the Birmingham Natural History and Microscopical Society. Microscopical Section. Read March 1st, 1887.

high a power as the 1-25th inch is readily and safely brought down into focus by the coarse adjustment alone, leaving the fine adjustment to be used only in the further examination of the object; and definite notice is received at once if the cover-glass of the object happens to be too thick for allowing the focussing to be effected, the only care that is requisite being never to go so far in the focussing movement as to stop all freedom of motion in the loose stage plate.

In the illumination of the object, the light is concentrated as usual by an achromatic condenser, so as to get a sufficient quantity of light passed through the minute face aperture of the objective, and a reflecting prism is used instead of the ordinary mirror, because with the mirror there are two reflections of every ray—the principal reflection from the silvered back of the glass, and a secondary one from the face of the glass,—and the mixture of these two sets of rays interferes with distinctness of definition. Special care has to be taken in the adjustment of the illumination, to get the direction of the light truly in the axis of the microscope and central in position, for obtaining a sharp definition with the objective. The immersion objective has an advantage in illumination over a dry objective, because the intervening film of water that is in contact with both the cover-glass and the face lens prevents the loss of light that occurs from partial reflection of the oblique rays by the exterior surfaces of those two glasses that occurs in a dry objective, on account of those surfaces being exposed to the air.

An object now shown in the microscope, under the 1-25th inch objective, is a minute circular diatom, *Aulacodiscus formosus*, which is only 1-100th inch diameter (as small as the finest needle), and this is magnified to more than 3 feet diameter with the highest power, only 1-8th part of the diameter being then visible at once. The surface of this diatom is beautifully marked with rows of dots symmetrically arranged, at a pitch of about 80 to the diameter of the diatom (1-100th inch), and the dots are consequently about 1-8000th inch apart; these are magnified to nearly $\frac{1}{2}$ inch apart, making a magnifying power of nearly 4000 diameters.

This power is measured by drawing the magnified object direct from the microscope with a camera prism, the distance of the paper upon which the image is drawn being fixed at 10 inches from the aperture of the eye-piece, which is the standard distance used for measuring the magnifying power of microscopes. A transparent micrometer scale divided into 1-100ths and 1-1000ths of an inch is then laid upon the microscope stage in the place of the object, and its image is similarly drawn upon the same paper. This scale upon the microscope drawing serves to measure the amount of magnifying, as directly and definitely as an engineer's or architect's working drawing is measured by the scale marked upon it. The accuracy of the whole is tested by checking the 10-100ths inch (or 1-10th inch) upon the micrometer scale by comparison with an ordinary 1-10th inch rule.

In the case of the 1-25th inch objective there was not the means of applying the micrometer scale direct in this manner, and the measurement of the magnifying power was effected by using the rows of dots upon the above-named diatom as a comparative scale for measurement. A drawing was first made with a 1-12th objective of a portion of the diatom, and a measuring scale drawn upon it direct from the micrometer scale, and then a drawing of the same portion of the diatom was made with the 1-25th inch objective; and by measuring the distances between the centres of the corresponding dots in the two drawings, the proportion between the magnifying power of the two objectives was obtained. The power of the 1-25th inch objective with the lowest eye-piece is found to be 1470 diameters, with the middle eye-piece 2280, and with the highest 3820 diameters. It performs well with the first and second eye-pieces, but breaks down in sharpness of definition with the highest eye-piece.*

THE SYNTHETIC PHILOSOPHY.

Students of the doctrine of Evolution, as set forth in the works of Mr. Herbert Spencer, will be interested to hear that a movement has been originated in Paris for the systematic study of the Synthetic Philosophy. The following gratifying letter, from Mons. James Grosclande, C.E., has been addressed to Mr. W. R. Hughes, F.L.S., President of the Sociological Section of the Birmingham Natural History and Microscopical Society, on the subject, to which a cordial reply has been made:—

Paris, le 15 Juillet, 1887.

Monsieur W. R. Hughes.

J'ai récemment envoyé une lettre à Mr. Herbert Spencer, l'éminent philosophe. Je lui faisais part de l'admiration que

* The objective described above is one presented to Mr. Marshall by the Exhibitors at the Bingley Hall Exhibition in connection with the visit of the British Association to Birmingham in September, 1886. Mr. Marshall was a member of the "Officers' Committee" for the Exhibition. (Eds. M. N.)

j'éprouvais pour la hauteur de ses vues philosophiques et pour l'énergie de caractère dont il a fait preuve pour mener à fin une œuvre aussi considérable que la sienne, œuvre dont un critique français, M. L. Carrau, a pu dire avec raison que c'était l'Encyclopédie de Hegel refait au point de vue de la méthode expérimentale.

Je lui disais en outre que, grâce au principe universel qui le domine, son système de philosophie synthétique est avant tout un système de conciliation et de paix. Or nulle époque, plus que la nôtre, n'a jamais eu besoin d'être aussi guidée par l'esprit de concorde. J'ajoutais que ses principes ne devaient pas rester cantonnés dans le domaine de la spèculation pure, soumis au seul examen des professeurs, et des philosophes *de profession*, mais qu'il fallait, grâce à une propagande active et éclairée de la part de tous ses disciples, qu'ils fussent connus de la masse du grand public qui pourrait ainsi en subir l'influence bienfaisante. "Dans ce but," disais-je à Herbert Spencer, "j'ai réuni un certain nombre de mes amis, jeunes gens familiers déja avec vos théories et ayant fait une étude sérieuse et méthodique de vos principaux ouvrages et je leur ai exposé mon intention de répandre vos idées dans un cercle aussi étendu que possible, en les présentant toutefois sous une forme appropriée à tous les esprits, même à ceux les plus étrangers aux questions philosophiques. Mes amis ayant adhéré à ma proposition, nous avons convenu de recommencer en commun, sous ma direction, l'étude générale et approfondie de votre système, d'en detacher les passages les plus saillants et renfermant les idées dont l'extension doit avoir l'influence sociale la plus salutaire, puis de rechercher les moyens à employer pour réaliser cette propagande que je regarde comme si utile par l'action bienfaisante qu'elle peut exercer sur la marche de l'esprit contemporain." Dans la lettre qu'il a eu la bonté de m'adresser le 12 Juillet dernier, Herbert Spencer a accueilli ma proposition favorablement et m'a souhaité de réussir dans la tâche que je m'impose. Il m'a appris (et je vous demande pardon de l'avoir ignoré) que vous avez tenté un effort dans ce but à Birmingham et que je trouverais près de vous toutes les informations désirables à ce sujet. En conséquence je vous serais très-reconnaissant, cher Monsieur, si vous vouliez bien avoir l'obligeance de me donner quelques renseignements sur la Société philosophique que vous présidez. Dans le cas où vous pourriez mettre à ma disposition, soit des livres, soit des publications quelconques relatives à votre œuvre, je serais très-heureux de les recevoir. Je vous rembourserais immédiatement les dépenses que ces envois pourraient vous occasionner. Je regarde comme un devoir pour tous ceux qui partagent les idées de notre illustre maître, Herbert Spencer, de joindre leurs efforts pour propager ses belles doctrines qui constituent aujourd'hui l'un des plus sublimes monuments elevés à la science et à la philosophie.

Recevez, cher Monsieur, avec mes remercîments anticipés, l'assurance de ma haute considération.

James Grosclande,
Ingénieur Civil,
96, Boulevard Diderot, Paris.

THE MIDDLE LIAS OF NORTHAMPTONSHIRE.

BY BEEBY THOMPSON, F.G.S., F.C.S.

(Continued from page 207.)

II.—Would the Water go into the Middle Lias Beds?

6.—There are two or three special matters bearing upon the question of the porosity of the Middle Lias which require some consideration. It has been rather insisted upon by some of the opponents of this water scheme that the water in the Marlstone travels only by means of cracks and fissures in the Rock-bed. I am quite prepared to admit that these fissures very materially aid the circulation of water in the Marlstone, but I am also quite certain that this is not the only way by which water travels.

If water travelled only by means of these fissures, an uninterrupted series of them must extend from the well where water is obtained to the outcrop of the bed, or catchment area, and then the water supply would vary with the season, but so far as I can ascertain, this is not the case with any deep well in the Marlstone; also, the finding of water would be much less certain than it is, and its efficient filtration doubtful.

No doubt the idea that water circulates only by means of fissures arises from the fact that when a well is made such cracks are commonly met with, and water appears to issue from them only; they not only form miniature wells for the water to flow into, but may extend some distance into the rock laterally, and so act as headings in draining it.

The extreme rarity of wells in the Marlstone not yielding water has previously been pointed out; nevertheless, much has been made of the fact that no water was obtained at the Spinney Well just outside Northampton, at a point less than a mile from a well in the same formation yielding at the same time some hundreds of thousands of gallons daily. In this well, of which a description has been given, headings were driven 352 feet to the north-west, and 141 feet to the north-east, but no flow of water could be obtained. The cause of failure was, in the first instance, attributed to the existence of an anticlinal curve, and afterwards to the closeness of the rock.

I have all along believed that an anticlinal curve exists in the valley where the Spinney Well was made, and that the general lowering of the water-level in the Marlstone had thus left the Rock-bed dry. The proofs I am now able to offer are quite conclusive as to the adequacy of this cause, and I am not aware of any reason for the alternative explanation.

Speaking generally for Northamptonshire, I should say it is a mistake to sink for water in a valley, now that the general water-level is so low, because it often happens that valleys coincide with, and, indeed, had their origin in, anticlines of the strata. It is really very common to find superficial beds dipping into the hills, and consequently forming under them synclinal curves, with corresponding anticlinals in the valleys. At three points at least on the new railway line between Weedon and Daventry (about four miles) this may be seen at the present time (1887).

When a curve is produced in a set of beds by upheaval at one part, or along one line, it is clear that the beds forming the curve will occupy a larger space than the same beds did whilst forming a plane. Those forming the lower part of the convex curve may preserve their continuity by re-adjusting themselves in obedience to the pressure above them, but the upper ones will crack, and that most deeply at the highest point of the curve. The exposed edges of the strata at the cracks being much more easily denuded than the surfaces of the same strata, we have here the initiative for the formation of a valley, under which, of course, the lower beds will form an anticline.

I not only think that many of our valleys have been *started* in this manner, but that "faults" have also been produced by shearing along the line of weakness produced by these cracks.

Returning to the SPINNEY WELL:—We find that it is situated at small, and nearly equal, distances to the south-east and north respectively of two other wells which have yielded considerable quantities of water from the Marlstone. Further relations between them are shown below:—

	Height of Surface above Sea-level.	Depth of Rock-bed from Surface.	Height of Rock-bed above Sea-level.
	FEET.	FEET.	FEET.
*Kingsthorpe Shaft	374	293	81
†Spinney Well ...	278	171	107
Billing Road Well	235	160	75

It will be seen from these measurements that the water-bearing bed at the Spinney Well is at least 32 feet above the same bed at the Billing Road Well; therefore, at a time when the water at the latter place would scarcely rise above the bed from which it came, it could not be expected that this higher portion of the same bed would yield water. If water had been obtained at the Spinney Well, then it would have been necessary to account for it either by a "fault," by a want of general porosity in the bed, or by a very high gradient in the saturation level arising from resistance; as it is, however, it became a proof of the absence of all these obstacles to the success of the water scheme under discussion.

I may say, incidentally, that a piece of the hard green rock containing *Terebratula punctata*, from this well, was thrown into some water, and on breaking it up in about fifteen minutes, it was found to be saturated with water throughout.

I was told that after salt water had been tapped, at a depth of about 800 feet, it rose to within about 145 feet of the top, but fluctuated about that level, probably running away into the Marlstone until properly stopped out. I do not attach much importance to the *depth* of the salt water, because, although it was given to me by one who might have known, he had not actually measured it. Considering that salt water at this time filled the old Kingsthorpe shaft to within 270 feet of the surface, that is, 104 feet above sea-level, it is scarcely possible that the same water at the Spinney

* I have taken the responsibility of altering the depth of the Rock-bed from 210 feet to 293 feet, believing that the evidence to follow amply justifies it.

† The section of the Spinney Well given in a previous page shows the Rock-bed to be at a depth of 164 feet, whereas Mr. Eunson ("Range of the Palæozoic Rocks beneath Northampton," Q.J.G.S., 1884) gives to it a depth of 171 feet. I have assumed that the latter is a correction of the former.

Well could rise 133 feet above sea-level; indeed, bearing in mind the general dip and strike of the Mesozoic beds, and the situation of these two wells respectively, one would expect a slightly lower level for the water at the Spinney Well. At any rate it is evident that the water must have risen quite or nearly up to the Middle Lias Rock-bed, for if we add to the depth of the Rock-bed at the Spinney Well its thickness of 7 feet 6 inches, making altogether 178½ feet from the surface, it will be evident that its base is 99½ feet above sea-level, and so, if the water rose as high as at Kingsthorpe shaft (104 feet above sea-level), the Rock-bed would be covered to the extent of 4½ feet, and the salt water would run away into it.

Kingsthorpe Shaft is situated a little over a mile from the Spinney Well, but is within sight of it; it was made 50 years ago with the idea of finding coal. According to the account left of the work, it has a depth of 967 feet, the Marlstone was reached at 210 feet, and yielded a supply of water equal to 36,000 gallons per hour. The shaft is now filled with salt water to within 270 feet of the top—that is, 60 feet below the recorded position of the Marlstone Rock-bed. No water now flows into it from any point above the salt-water level.

I should not think of calling in question the accuracy of any of the figures given above but for the fact, well known, that no detailed section of the shaft was taken at the time it was being made, hence errors of depth might easily be made.

Shortly after the Spinney Well was abandoned, the Kingsthorpe shaft was opened to see if the Marlstone there continued to yield water. A small quantity of water was found to be making its way into the pit near the surface of the ground, but when that was stopped there was no flow anywhere. The lining of the shaft was broken through and the rock tapped, at short intervals, from the surface of the water to a considerable distance above it, but no water obtained. In April, 1881, I made a slight investigation of the pit, at the request of Lady Robinson, on whose land it is situated. A workman broke the lining of the shaft, or utilised the openings already made, and brought up small specimens of the rock from numerous depths between 150 feet and the surface of the water. The rock in every case was clay, and although, in the absence of fossils, one might be easily misled, my impression was that it was all Upper Lias, and that the Middle Lias Rock-bed was below the water level, and so at least 60 feet lower than its supposed position.

We will assume for a moment that the depth of 210 feet for the Marlstone is correct, then the section would be about as below :—

	FEET.	
Great Oolite, Inferior Oolite, Upper Lias	... 210	
Middle Lias ...	... 21	(Spinney Well Estimate.*)
Lower Lias ...	... 629	
Sandstones ...	... 80	
Red Marl... ...	... 12	
Conglomerate ...	... 15	
	967	

The notes respecting the last three beds are said to have been made by Dr. William Smith, F.R.S., F.G.S., and Mr. Sharp, in whose possession they were, appears to have quoted the thicknesses of the upper one and the sum of the beds above it differently in two separate papers.† In the earlier one, he says, the Lower Lias was pierced at a depth of 860 feet, and 80 feet of Sandstones met with; in the later one 880 feet and 60 feet are the thicknesses quoted for the same things. It may be that the second figures are a correction of the earlier ones, and certainly the thickness of the Sandstones agrees better with the Spinney Well record; nevertheless, I have preferred to retain the earlier ones, although less favourable to the particular contention founded upon them.

Now the total depth of the Kingsthorpe shaft is no doubt correct, the thicknesses of the lowest three beds are probably so; but if we accept the other figures given, then, (1) The Lower Lias must have a thickness of 629 feet, that is, 83 feet more than at the Spinney Well, about a mile away; (2) The Marlstone Rock-bed is 164 feet above sea-level, that is, 89 feet higher than at Northampton, and 51 feet higher than at the Spinney Well; (3) The thickness of 210 feet for the Great Oolite, Inferior Oolite, and Upper Lias is less than might be expected.

Considering that after the termination of the Carboniferous land period the inequalities of surface then produced were largely obliterated by deposition of the Permian or Trias, or both, and that the highest parts of the Carboniferous limestone in this very district were covered by the latter, it is

* "The Range of the Palæozoic Rocks beneath Northampton," by Henry J. Eunson, Esq., F.G.S. Q.J.G.S., August, 1884.

† "The Oolites of Northamptonshire," Part I. Q.J.G.S., August, 1870. "Note on a Futile Search for Coal near Northampton," Geol. Mag., Vol. VIII., p. 505, 1871.

quite incredible that the Lower Lias would vary in thickness by more than 80 feet at two places only about a mile apart. An anticline could not account for the increased thickness of any bed of the section at Kingsthorpe, and if it could the suggestion would be entirely opposed to the evidence which can now be obtained with regard to the superficial beds, for the Upper Estuarine Clay just at the edge of the hill, where the Kingsthorpe shaft is situated, is at the same level as the Great Oolite limestone a little further on the hill, and must, therefore, dip below it. By giving the Lower Lias a thickness of 546 feet, the same as at the Spinney Well, the Marlstone would be at a depth of 293 feet from the surface.

To get a correct idea of the thicknesses of the beds above the Middle Lias it is necessary that measurements should be made where undenuded Upper Lias and Inferior Oolite at least are met with, and preferably where the Great Oolite forms the Upper bed. The nearest place I can appeal to as supplying the information is Duston, situate a little less than three miles from Kingsthorpe shaft. In a well made at Berry Wood Asylum the following beds were passed through :—

Section of Well at Berry Wood Asylum.

		FEET	
Upper Estuarine...	Clay	about 20	*Sunk.*
Inferior Oolite	Sand	,, 50	
	Sandstone (like that in the quarries at New Duston)	30 to 36	
	Blue greasy stone ...	3	*Bored.*
Upper Lias	... Clay	190	
Marlstone	... Hard bluish stone...	3	

The spring at the base of the Inferior Oolite was used for some time before the boring to the Marlstone was made.

It is known that the Upper Estuarine beds of the Great Oolite at Kingsthorpe are about 20 feet thick, the same as at Duston, because they were once worked for brickmaking, and if we add to these 83 feet of Inferior Oolite (Northampton Sand) and 190 feet of Upper Lias (the minimum of each at Duston) we get 293 feet as the depth of the Marlstone, the exact depth arrived at from a different set of data, a result certainly remarkable, and therefore strongly confirmatory of the contention that the Marlstone at the Kingsthorpe Well is below the present water-level there.

Altogether, then, it appears that the wells at Kingsthorpe and Northampton which yielded water tapped the Marlstone at a lower level than that formation had at the Spinney Well.

It is scarcely necessary for me to point out that so long as the bed is continuous, the presence of an anticline in the

Marlstone, at any point, would not in the least degree be a drawback to the success of a dumb-well constructed there.

Other evidence with regard to the continuity and general porosity of the Marlstone will better appear in the next Section.

(To be continued.)

Review.

The British Moss Flora. By R. Braithwaite, M.D., F.L.S. Part X. L. Reeve and Co. 10s.

This part, which will be welcomed by moss students, concludes the first volume of this valuable work, and is about one-third of the whole work. It is illustrated by nine plates, on which are given delineations of forty-five species, and of these plates no word of praise can be said too much. The letterpress, of which there are seventy-eight pages, contains descriptions of the remaining species and varieties of Tortulaceæ, including the conclusion of the genus Mollia and the genera Leptodontium, Barbula, Leersia (the Encalypta of British authors), and the one British species of Weberaceæ of Ehrhart, *Webera sessilis (Diphyscium foliosum*, Mohr), illustrated by a full-page plate, which is a most beautifully finished one.

Since the monograph of the genus Fissidens (Part IV. of this work) was published, Mr. Mitten has published in the Journal of the Linnean Society an important paper on this genus, which adds considerably to our list of species, and alters many of the older views. To bring the present work level with the times Dr. Braithwaite gives in this part eight pages containing descriptions of the new species, and also all alterations in nomenclature deemed needful. These are illustrated by one plate, and the extra pages are so paged that they may be added to Part IV. without any alteration of the general paging. In addition to this is a Supplement giving descriptions of the various species that have been added to our flora whilst the work has been in progress and since the issue of the various monographs to which they belong, and this is so well up to date that the newest addition to our flora is fully and well described. There are also addenda giving new localities for some of the rarer species, and a classified list of all the species described in Vol. I., and it is to be hoped that this latter may be completed and issued separately, as it would be a valuable aid for indexing herbaria, &c. The part concludes with a full index, title-page, &c., so that the volume forms a complete series of monographs of the various genera at present treated.

The volume is also published in a complete form, containing forty-five plates, and giving details of 225 species, with 3,000 figures. Of these species about eighty are additions to the British Flora since the publication of Wilson's "Bryologia Britannica," descriptions being also given of an equal number of varieties not recorded by Wilson.

It is much to be desired that the two concluding volumes may be passed through the press at a quicker rate than the one just now completed, and that the talented author may be spared not only to complete his great and valuable undertaking, but also to reap the honour he so richly deserves. J. E. Bagnall.

Wayside Notes.

"The Naturalists' Monthly" is a new journal devoted to the interests of Nature-lovers and Nature-thinkers, the first number of which will appear synchronously with the present issue of the "Midland Naturalist." If we may judge by the prospectus, it is intended to enter into competition with our well-known contemporary "Science Gossip," but of this the first number will give a clearer conception. It is to be edited by Dr. J. W. Williams, and published by Walter Scott, Warwick Lane, Paternoster Row.

Probably the most marked feature of the Meeting of the British Association at Manchester, commencing on August 31st, will be the number of foreign visitors who are expected to take part in the proceedings. Somewhere about 120 of these are expected. Perhaps the most remarkable assemblage will be on the botanical side of Section D. To mention the name of Professor Sachs, of Würzburg, is to bring to mind one who stands head and shoulders above all his contemporaries as a physiologist; though scarcely less renowned is Professor Anton de Bary, of Strassburg, distinguished alike as anatomist, morphologist, and fungologist. Cohn, of Breslau; Count von Sohns Laubach, of Göttingen; Pringsheim, of Berlin; Da Saporta, of Aix; Dr. Treub, Director of the Botanical Gardens at Buitenzorg, Java; and Professor Asa Gray, of Harvard, complete a gathering of foreign botanists such as this generation will scarcely have seen before.

Hayes Water.—Walking in May last from Mardale to Patterdale, in Westmoreland, by way of Kidsty Pike and High Street Mountains, I diverged down to this lonely mountain tarn (which should not be confused with the much larger lake of Hawes Water), being attracted by its clean seclusion and pastoral enclosure of long, grassy hillsides; but was most struck by the great number and uniformity of shape of moraine masses grouped about the south-east and north-west ends of the little lake (which is 1,383 feet above sea level), looking almost artificial, and arresting the attention by their totally different aspect from ordinary weathered *detritus* at the base of cliffs or below long slopes of rock, and having something of the regular shape and rounded contours of broad, colossal beehives; several are like these, with one side slightly flattened against the mountain. So uniformly and beautifully rounded are they, and so numerous, you see at once some special agency has been at work in the far past to produce them, although quite recently in a geological sense. The entire long, narrow valley has every appearance of being in a perfectly natural condition, and this agency, *there so very decided*, I can imagine to have been none but that of glaciers once present in the valley, and probably very slowly retreating upwards as the climate ameliorated, until at length the present conditions prevailed. I can strongly recommend the study of this particular valley of Hayes Water to geologists, it being comparatively little known; and it is easily reached by diverging to the right, on descending from Kirkstone Pass towards Patterdale, directly after passing the interesting lake of Brothers Water.—Horace Pearce, F.G.S.

Tolypella intricata in Beds.—This was first observed in this county on March 3rd, 1883. It was growing in a small pool about three yards long, by two yards wide, and about two feet deep. In the course of the succeeding month it had attained its full development, when it filled two-thirds of the pool. During the succeeding year (1884) there was not the least trace of it, but in the following three successive seasons, viz., 1885-6-7, it has appeared in the same station in limited quantities. This is so unusual an occurrence in the history of this plant, as known in Britain, that it will probably interest the readers of the "Midland Naturalist" (*vide* Messrs. Groves' "Review of the British Characeæ," "Journal of Botany," 1880, p. 163, pl. 209; in reprint, p. 16). The uncertain appearance of these plants and their apparent independence of roots is worthy of note. The writer has at the present moment living *Nitella mucronata* in an aquarium, gathered more than a year ago, and in obtaining them they were broken off about the roots, so that they have existed without them, never having developed any during that period.—J. Saunders, Luton.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—Microscopical Meeting, August 2nd, 1887. Mr. Thomas Clarke exhibited piece of fossil wood and three siliceous pebbles brought from the Soudan by Gunner W. Allen, E Battery, Royal Horse Artillery. Mr. Edmonds exhibited a specimen of rose with the sepals of calyx converted into leaves. Mr. Bolton exhibited specimens of male and female *Asplachna intermedia*, a rare rotifer found at Hartshill.—Biological Section, August 9. Mr. R. W. Chase in the chair. Mr. J. E. Bagnall exhibited and described for Mr. W. R. Hughes a fine series of plants representing the rarer flora of the Medbourne district of Leicestershire, and containing *Vicia sylvatica* and *Euonymus Europœus;* these were all collected by the Rev. T. Norris, Rector of Alexton, and one of the authorities referred to in the "Flora of Leicestershire." Mr. W. P. Marshall exhibited a collection of plants from Hartlebury Common and the neighbourhood, including *Sagittaria sagittifolia*, *Carex ampullacea*, *Jasione montana*, and *Comarum palustre*.—Geological Section, August 16. Mr. Thomas Clarke in the chair. Mr. Horace Pearce, F.G.S., exhibited specimens of silver-bearing rocks from the Rocky Mountains near Pueblo, in Colorado, United States. Mr. Bolton exhibited specimens from the Severn at Hampton Loade of the rotifer *Lacinularia socialis*, and of a curious Caddis larva in a transparent case, having vibrating gill appendages. Mr. Reading exhibited a specimen of *Daphnella Wingii*, an entomostracan from Sutton Park. Mr. Rabone exhibited a photograph from Dunedin, in New Zealand, showing very luxuriant vegetation; also a specimen of a double kidney bean. Mr. Wilkinson exhibited for Mr. Pumphrey a specimen from Switzerland of the lichen *Usnea barbata*, variety *florida*, that was beautifully in fruit. Mr. Marshall exhibited a number of plants collected in the Dingle, near Hampton Loade, and the neighbourhood, including the following rare specimens:—*Hypericum androsæmum*, *Dipsacus pilosus*, *Vicia sylvatica*, *Viburnum opulus*, *Eupatoria cannabinum*, and *Cynoglossum officinale*.—Sociological Section, August 23rd.—Mr. Bolton exhibited the freshwater alga, *Hydrodictyon utriculatum*, from Sutton Park. Mr. Reading exhibited the very rare and most remarkable rotifer, *Pedalion mira*, which so much resembles the nauplius larva of an Entomostracan in its jumping movements, from a new locality, King's Norton.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—June 27. Mr. Deakin exhibited specimens of *Pupa umbilicata*, var. *edentula*, and *Helix pulchella*, from Brecknockshire, also a curiously distorted specimen of *Anodonta anatina*; Mr. J. Madison, specimens of *Patella longicosta* and other shells, from Australia, also a small collection of insects from the same place. Mr. H. Insley then gave an address on "*Ranunculus repens*: A Study." This plant was chosen because it was very common and belonged to the first natural order. It was described from the root to the flower, the minute structure of each part being enlarged upon. The concluding part dealt with its development, and recommended the structure and physiology of plants as a subject of greater interest than their mere classification. A large number of slides and diagrams illustrated the subject.—July 4. Mr. J. W. Neville exhibited a leaf of cabbage showing an abnormal growth; the midrib had divided, one portion springing from the centre of the leaf formed a stem, on the summit of which a pitcher-shaped leaf was borne. There were many instances of this growth in the same garden. Mr. J. Madison exhibited specimens of *Limnæa glabra* and *Paludina contecta*, from Yorkshire—the latter shell is said to be extinct in that county; Mr. Mulliss, ruby-tail fly, *Chrysis ignita*. Under the microscope Mr. H. Insley showed coniferous glandular structure.—July 11. Mr. F. Holden read a paper on "A Day's Ramble over the Marlstone of East Leicestershire." The writer described the journey to Burrow Hill, where the marlstone was first worked on its bluff escarpment. Pickwell was next reached, and yielded some very perfect specimens of Cerithium and the largest Belemnites he had met with. At Illstone were found five species of Ammonites. The journey was then continued to the railway cutting at Tilton, where a fine exposure of the formation was seen; these rocks yielded many fossils, including a vertebral column of Ichthyosaurus. These beds also contain iron, the lower ones in the form of a carbonate, the upper ones as a peroxide. The top bed was surmised to be the top bed also of the formation. The writer concluded an interesting paper by describing the percentage of iron found in the marlstone, which, though small in quantity, was so readily extracted that it opened up a wide field for commercial enterprise. The fossils collected were exhibited.

CARADOC FIELD CLUB.—The third meeting of the Club was held on August 10th at the Breidden Hills. The interest of the meeting was mainly geological; the chief features of the Hills in this respect being pointed out by Mr. W. W. Watts, M.A., F.G.S., who has devoted special attention to the district, and whose paper on the subject appeared in the Quarterly Journal of the Geological Society for November, 1885. An address was also given by the Rev. D. P. Lewis, President of the Oswestry and Welshpool Field Club, on the claims of the Breidden to be the site of the last stand of Caractacus (or Carádoc), against the Romans under Ostorius Scapula, as related by Tacitus.

DUDLEY AND MIDLAND GEOLOGICAL SOCIETY.—The fourth field meeting of this society for this season was held on August 8th at Minsterley and the Stiperstones. On arriving at Minsterley station carriages conveyed the party to the Snailbeach lead mines, where, by the kindness of the proprietors and H. Dennis, Esq., the manager, they inspected the several processes of raising, sorting, crushing, and sifting the ores, and also the mode of smelting and casting the pig lead. The ore is raised from a depth of 500yds. in the Llandeilo rocks, and no doubt the veins of lead ore were worked at the surface by the Romans both here and at other places in this neighbourhood. A Roman pig of lead was found here by some workmen in 1851 while sinking through a heap of slag, which bore the following inscription in raised letters:—IMP. HADRIANI. AVG. A number of interesting specimens of the various minerals raised here were placed at the disposal of the party, consisting of galena, zinc blende, quartz, amethyst quartz, carbonate and sulphate of baryta, calcspar, &c. The drive was then resumed to the Stiperstones, several exposures of Llandeilo rock being noticed on the way. On reaching the summit and after having climbed to the Devil's Chair, the members opened their stores of refreshment and enjoyed a well-earned repast. Then the president, Mr. Horace Pearce, F.G.S., gave the following short address :—This ridge of the Stiperstones, described by Sir R. Murchison as Lingula Flags, Dr. Callaway has shown to be the equivalent of the Shineton Shales and Tremadoc Series (as referred to in Mr. D. La Touche's recent admirable work on the "Geology of Shropshire.") In this district occur rocks, some of which are among the most ancient in these islands, as at the Ercall, Wrekin, and Primrose Hills, the Caer Caradoc, Hope Bowdler, and other portions of the Stretton Hills; notably at Pontesbury Hill, or Pontsford, only a short distance from the Stiperstones, where not long ago I was interested to find specimens of remarkable intrusive and changed rocks, such as Diorite, Felsite, varieties of Basalt, and forms of what are now generally reckoned as Archæan, singularly varied and intermixed in a small area about this hill, changing often in a few yards in a striking degree. These have been described by Dr. Callaway, and are most interesting to study on the spot. Then, again, we find these primeval rocks, if I may so term them, occurring further north; largely seen in some of the Hebrides, those wild islands off the West Coast of Scotland; and probably more instances of their being found on the surface will yet result, for I cannot but think they are not yet fully investigated, the intrusions and faultings being so frequent and so complex, while the present openings in the hills are, comparatively speaking, so few, and at intervals so great. These Archæan rocks are closely allied to the Laurentian of Canada, which are also still under discussion, and, as probably forming the original backbone of our islands, have an interest of great extent, especially when we remember the enormous range of their development in the remote past, followed by denudation of proportionate magnitude. For I would remind you, in relation to this subject, that Professor Hull considers that in a far-gone geological age there existed a vast tract of this most ancient land, where part of the North Atlantic Ocean now is, what one may call an old Continental Area of land, the ruin of which went largely to build up subsequent formations, themselves to suffer degradation, in the sense of being worn down, to form rocks of enormous thickness in ages still geologically nearer our own brief period. Of this *old land* there are here and there the fragments, such as those worn Hebrides, still suffering the wasting of the ocean storms. And upon this subject of denudation or disintegration of rocks we should remember that this bold, castle-like crest of the Stiperstones is but a trifling portion, a mere *relic* of once great and lofty masses; just as Snowdon is but an inner relic of its once gigantic substance—frost, lightning, air, and water having worn down that great mass into the picturesque mountain we now admire.—Mr. Pearce then read to members present some extracts from La Touche's "Geology of Shropshire" upon this district. Mr. W. Madeley also mentioned the interesting fact that Dr. Callaway had discovered that the strike of these Archæan hills was not originally in accord with their present trend, showing that they were parts of chains of hills which have been subjected to an enormous amount and length of erosion, and represent but the ruins of former mountain chains. The botanists were not at all fortunate in finding the rare plants which are noticed as occurring on these hills, owing, no doubt, to the long dry season; the only plants which were reported were *Empetrum nigrum* and *Vaccinium Oxycoccus* and *Vitis-Idæa.*

ON THE RECENT RIVIERA EARTHQUAKE.*

BY W. P. MARSHALL, M.I.C.E.

This terribly sudden catastrophe, on 23rd February last, by which more than 1000 lives were lost, and a great number of buildings destroyed, was of special interest because the locality where it occurred is a favourite resort for visitors from this country, and many here had personal friends who experienced some of the effects of the earthquake. I happen to have had some friends there at the time, two parties in different places, from whom interesting particulars have been received of their personal experiences of this earthquake, which so rudely disturbed the charming calm retreat of the Riviera. That favourite place being the resort of invalids for winter quarters on the mild shores of the Mediterranean made the occurrence specially distressing, and terrible sufferings were caused to many invalids by their being suddenly turned out of doors by the destruction of the buildings in which they were staying. Although earthquakes have been experienced there before, three others having occurred in the district within the present century, in 1818, 1831, and 1854, these were only comparatively slight in amount, and no apprehension of such a calamity as the recent earthquake was entertained.

The Riviera (the name signifying "shore" in Italian) is a long narrow strip of shore, at the foot of a mountainous district that extends down so close to the sea as to leave only a narrow strip with precipitous cliffs and deep ravines, which is occupied by a succession of towns and villages, extending for about seventy miles distance from Cannes to Alassio, and in the more closely populated portion lying at only three or four miles distance from one another. In the fifty miles further distance on to Genoa is the celebrated "Cornice Road" with its lovely views of sea and mountain, and about ninety miles in the other direction we reach Marseilles. The line of railway runs close along the shore most of the way from Marseilles to Genoa and on to Leghorn, that being the only passage available at the foot of the mountainous district.

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* Transactions of the Birmingham Natural History and Microscopical Society, Geological Section, read May 17th, 1887.

The railway was obstructed by rocks that were thrown down by the earthquake, and by damage to the tunnels; and the traffic between Mentone and Cannes was stopped for a day by a landslip. The earthquake was also felt slightly at Turin, Parma, Leghorn, and Marseilles; there was also some indication of it in Austria and in France, and as far north as Cologne. In Mentone, which was in the district that suffered most, a large number of houses were so much shaken as to become dangerous, and required partly pulling down. The smaller town of Diano Marina was nearly destroyed, many of the inhabitants killed, and a large number injured; the great amount of personal injury in this case was attributed to the circumstance of the houses being mostly built over large vaults, in which casks of olive oil were stored, and in the earthquake the people were precipitated into these vaults with the ruins of the houses. The towns of the Riviera generally are marked by being built with a special provision against the effects of earthquakes, in arched buttresses extending across the narrow streets at various levels, to support the walls of their somewhat high-built stone houses. Taggia was another place that was nearly destroyed by the earthquake, and at Oneglia the houses generally were so much shaken as to be in danger of falling. In many towns the people had been caught in the act of escaping from their houses, and became buried in the ruins; and the danger of the remaining walls falling was so great as to make the rescue of those buried a very difficult work. This difficulty was terribly aggravated by a recurrence of the earthquake shocks several times, which, though weaker in intensity, were sufficient to bring down more of the already damaged walls.

The occupants of the damaged hotels rushed out of doors on the first shock, and mostly remained camped out in the open air during the next night, some in arm-chairs, some on benches, some in tents, some on tables, and some in waggons, carriages and hotel omnibuses, and in bathing machines. The first shock occurred early in the morning, a little before six o'clock, when all were in bed, and the visitors rushed down instantly and out of doors, with very little clothing in many cases, and only able to obtain a further supply afterwards by getting clothes thrown out to them from the windows of their hotels.

The following graphic account has been received from one of my friends, whose party was at Mentone, sleeping at the top of one of the large hotels. They were awaked by a horrible crash, and walls and roof seemed cracking in with a terrific sound; in one bed-room the window was smashed, and light was seen through a gaping crack in the outside wall. They snatched up such things as they could lay hands on, and rushed down the lofty marble stairs, which seemed to sway as they passed, and afterwards partly gave way under the subsequent shocks. It was then scarcely daylight (being in February), and all the company assembled in the hall and seemed to pause a little; but another alarming shock quickly came, and they flew down the flight of steps out into the garden of the hotel. It is remarked that never will they forget, as they shivered out there in the cold early morning, the sight of the horrid vivid red glow on the jagged mountains above (though so beautiful a scene at other times), as the sun rose on all this horror and destruction, and it seemed as if the end of the world was upon them.

The scenes around were sad enough. In the hotel a dying gentleman with nurse was left inside, and a lady dying was left in the next large boarding-house; both were at last carried out and laid in the garden, where also was a poor lady lying motionless on blankets in an attack brought on by fright. About two hours after the first two shocks, when it was supposed the shocks were over, another third one occurred, and after that they were unable to go into their hotel again, and some of the clothes left in their rooms were lowered to them in a sheet out of a window. They went on afterwards towards the railway station to endeavour to get away from the place, and were pulled up on the way by a sensation "resembling a horrible immense hot snake wriggling under their feet." At the railway station they found the roof and walls so cracked that they feared to go in, and having learned that the railway bridge beyond the station was cracked, and that the succeeding towns to Mentone were also in a bad state, they stopped the night at Mentone, and managed to hire for 100 francs a small carriage to sleep in. Another slight shock occurred in the afternoon, and though no more shocks occurred that day beyond slight tremours, no one who has not gone through it can possibly understand how the recurrence of tremours, though slight, keeps the mind in a sense of suspense and expectation that makes it impossible to rest. It was reckoned that there were altogether from thirty to forty shocks of different degrees.

The other party of friends referred to were also staying at Mentone, but at a distant part, which was much less affected by the earthquake, and the hotel where they were sleeping was higher up on the rock, and was not damaged. They were sleeping on the first floor above the ground, and were roused by an extraordinary sound, and at once thought of an earthquake, and just managed to get dressed somehow, when the disturbance came again, and they instantly rushed down stairs, and after looking out to see that no stones were falling, ran down the steps into the garden. The sea was visible from the end of the garden, and they went out to see if there was any tidal wave to be seen, but the whole surface of the water was quite calm, and no signs of any wave. A solitary fishing boat was lying off at some distance from the shore, and the men in it were stated to have said afterwards that they did perceive a considerable rise and fall of the sea at the time of the shocks.

The luggage was all packed up at once ready for a removal, and during this occupation the third shock came (the one about a couple of hours after the first ones), when there was another stampede of the occupants of the hotel, and the party went off to the railway station, which was situated higher up the mountain slope, and found the trains continued running. The lower portions of the town were seen to be greatly damaged, and it was expected the other coast towns of the Riviera would be similarly effected, so the party decided to escape at once into France by Marseilles to Lyons, and thus round into Switzerland, as the best chance of being able to sleep in peace. In this they were successful, but they found at Lausanne that the shocks had been felt there and at Geneva, although only slightly, and noticed only as matters of curiosity and of no importance. Their fellow-travellers from Mentone were a French family with children and servant, who had been staying in another hotel that was much damaged by the earthquake. At the first shock the ceiling of the room fell upon them and upon their clothes, and they could not find more than a few wraps, and fled down the stairs with their children and servant, who had only a few things tied up in her apron. They managed to get down between the first and second shocks, and the second one brought down the marble staircase bodily, and little dressed as they were, they went off in that way by the train through to Paris. Fortunately it was a lovely day for the travelling, but the apron full of things was all they had been able to bring away out of the 200 kilos of luggage they had taken out with them for their excursion.

In Mentone, a large portion of the town was seen to be greatly injured, and some lofty newly-built hotels and some new villas had suffered severely; there were even two houses with the ends out, and the beds and furniture in the rooms were visible outside. Several invalids lay upon beds on the pavement, with débris of all kinds from the fallen buildings lying about. At San Remo, however, about fifteen miles distant, it was learnt from an eye-witness that the buildings had suffered very little. San Remo is one of the largest and most typical of the Riviera hill-towns, and the houses are all clustered round the lump of rock on which it is built, and the winding streets are in many places completely arched over, with houses built over the arches; and in others they are very narrow, with lofty houses on each side, and the houses are tied together with arches after the manner of flying buttresses, high in the air. These arches are said to have been intended to protect the houses in the case of earthquakes, and now it seems they have done good service in this way. It would be interesting to know how far the old interlaced system of building has stood firm in other towns of the Riviera, when so many of the detached modern structures have been shaken to pieces.

Earthquakes and volcanic eruptions are not to be looked upon as exceptional phenomena, but as portions of the regular chain of events in the progress of the earth, and as necessary occurrences from time to time; not only necessary results from the causes that are in constant operation, but also necessary changes in elevation of the earth's surface to counteract the constant levelling action of atmospheric and water denudation. These last forces are continually wearing down the mountains and hills, and depositing the débris to fill up the ocean; and if there were no counteracting forces, it would only be a question of time for the inevitable result to be brought about, of the land being all levelled down to the sea and the water spread over the whole surface of the earth, making it uninhabitable except for aquatic life.

The constant gradual cooling that is taking place in the whole earth, in consequence of the annual loss of heat by radiation into space being greater than the annual supply of heat received from the sun, causes a continuous (though very slow) and gradual reduction in size of the whole earth, and a corresponding reduction in its circumference. As the surface is rigid and not elastic, this contraction of circumference can only take place by the compression and crumpling up of the surface, and as the surface is not homogeneous, but on the contrary, varies greatly at different parts in its hardness and soundness, this compressing and crumpling up action has more effect in some localities that are weaker and more yielding, than in others where the surface is more solid. The weak places in the earth's crust are thus found out, and although the acting cause is continuous and uniform, the resulting disturbances consist of an irregular series of interrupted starts and jumps, as the successive weak points give way under the severe lateral pressure, causing the disturbances of the earth's surface that are felt as earthquakes. These vary greatly in intensity from the slight tremours that have been felt occasionally in this country, seldom sufficient to do serious damage, to the fearfully destructive earthquakes of other places in which whole towns have been suddenly destroyed; there appear to be certain permanent lines of weakness in the earth's crust, such as the west coast of South America, where these occurrences are much more frequent and more severe than elsewhere.

It has been inferred from careful examinations of the various directions of the forces exhibited in earthquakes, that these forces radiate from centres of action at moderate depths below the surface, extending probably to not more than thirty miles depth at the greatest, and often but little exceeding the actual inequalities upon the earth's surface, namely, five miles the height of the highest mountains, and five miles the depth of the deepest seas, making ten miles total variation in level of the surface of the earth. The earthquake phenomena may consequently be looked upon as really occurring in the superficial portion of the crust of the earth, to a depth probably only two or three times greater than the present inequalities upon the surface; and although the damage caused by them to life and property is occasionally very severe in amount, it may be questioned whether the annual loss from this cause is really any greater on the average than that arising from storms and floods, the other destructive causes that are in continued action on the earth's surface.

It may be added as an experience of actual beneficial effects from an earthquake that has recently occurred in North America, where a series of violent earthquake shocks have just taken place in Arizona and Mexico, and at twenty miles distance from Tucson, in Arizona, that a crater has been formed on a mountain, from which streams of water have burst forth, redeeming a vast area of country that was previously unwatered and sterile; also in the same vicinity large tracts of the Santa Catalina mountains were torn asunder, revealing rich veins of gold, that were previously unknown. The same earthquake was also felt at Guaymas, on the coast of Mexico, but there, unfortunately, great damage was done to the buildings and many lives were lost.

INDIVIDUALISM IN ART.*

W. KINETON PARKES.

The 19th Century is remarkable by reason of the four great movements in Thought which have characterised it. The first was that originated at Oxford by the publication of the "Tracts for the Times." This, with Cardinal Newman at its head, has had a most potent influence upon national life, and was the stirring in Religion which corresponded to the next of these great movements, the Renaissance of Art in England, which had been commenced years before by Blake. The Pre-Raphaelite Brotherhood, with Dante Gabriel Rossetti as their leader, made an effort for English Art which it sorely needed. In the whole of the history of Art in this country, no such movement had before taken place, and most happily it came at the right moment. English Art was falling into evil repute, for its chief characteristics were inanity and childishness, and an utter want of poetry and feeling. The Pre-Raphaelites made a step in the right direction. They went direct to Nature for their inspiration, in the true spirit of the dwellers in the 19th Century. The next movement was the revolution in Philosophy. The philosophers, as well as the artists, went to Nature, and the result was *Evolution.* Darwin and Mr. Herbert Spencer were the prophets. The last movement of the century is, it seems to me, the application of the scientific method to Literature. In this we still await the prophet; that he is born and among us, although at present we hardly know where to find him, is certain. Soon we shall make the discovery, and the devotees of the new Literature will gather round his standard, as the devotees of the new Philosophy gather in the library formed by the volumes which compose the "System of Synthetic Philosophy"; as the devotees of the new English Art gather in the galleries where Rossetti, Holman Hunt, Burne Jones, and Watts are represented. It is the scientific method to which the adherents of the synthetic philosophy must give their aid and their abilities, the scientific method devoted to all branches of thought and knowledge. It is the method of the times, and the one which alone will serve. It must be applied to religion, to philosophy, to literature—to poetry as

* Transactions of the Birmingham Natural History and Microscopical Society, Sociological Section, June 16th, 1887.

well as to prose—and to the fine arts. Above all must it be applied to social problems, to the exclusion of party politics, with their baneful and pernicious influences.

That this influence is being felt in all directions is plainly evident. We see it in the utterances of a bishop of the Church of England; we see it in the references of purely literary men to the writings of Mr. Spencer, Prof. Huxley, and Darwin; we see it in a small degree in some of the novels of the day; we see it in the articles we find month by month in the magazines and reviews; we see it in modern poetry; and we see it in the exactitude with which our great living artists paint natural phenomena. That this movement is one of the greatest importance, and of the utmost value, goes without saying, for while there is nothing lost, many things are gained. Often a seemingly beautiful work of art has been spoilt by an imperfect training in anatomy or optics. In many instances, what would otherwise have proved a noble poem has, from lack of scientific knowledge, been ridiculed and forgotten; and frequently we find in religion a very beautiful idea when first looked at, which, when examined by the light of truth, becomes absurd or worse.

The leaven of Science has been introduced into Literature and Art, and the whole will in time be leavened. Vibrations emanate from Science and are communicated to the affairs of our life. Motion has been imparted to the mass, the equilibrium has been disturbed, and has become a "moving equilibrium." "Every active force produces more than one change—every cause produces more than one effect." * The scientific method is the "active force;" the changes it has produced and will continue to produce are obvious. The increased knowledge afforded by the researches of Science are the "cause"; the effects are the fuller knowledge of truth, the higher view of life, the nobler aspect of Nature, and the more reasonable, though not less reverent, attitude towards religion.

To show how intimately related to Science all Art is, it is only necessary to remember that for our knowledge of the earliest Art we are directly indebted to Geology and Archæology. The very earliest forms of Art we know are the drawings made by primitive man. In the cave deposits we find bones and antlers with rough, but in most cases, very correct drawings (which cannot be said for a good many of the drawings turned out by our most highly-trained School of Art three-days-a-week students) of the animals who lived

* Herbert Spencer. Essay on "Progress."

around him; these drawings are fairly numerous, and represent the most elementary stage of the plastic arts. These cave men were excellent artists in their way; their names have not come down to us, so we cannot speak familiarly of them, but, nevertheless, we feel our indebtedness and give them our thanks accordingly. Next, speaking roughly, after the drawings on the bones found in the cave deposits, come the remains of early pottery, rough masses of clay moulded by the hands and sun-dried. Then we get pottery made on the primitive potter's wheel, and dried by fire. Then come rude attempts at ornament, drawings on the outer surfaces of the domestic utensils made of clay, or carvings on the exteriors of gourds. The development of pottery through the varied forms of domestic utensils, urns for the ashes of the dead, and other things ornamental and useful, at length resulted in Sculpture.

Where Painting commenced it is difficult to say. It is certain, however, that it is a development from the drawings of the cave men, and probably progressed along with pottery, but from its nature all remains of its earliest forms have perished. The various forms of fresco, oil, and water-colour painting with which we are familiar are naturally a high development. We know that the Greeks were acquainted with the art of painting, but from the evidences which have survived it seems certain that this Art had not reached to anything like the perfection to which its sister art, sculpture, had attained.

Music has had a most remarkable development, consisting first in the beating of drums and other rude instruments, which formed an accompaniment to the savage yells and cries, and still more savage and hideous dances and contortions of the body, of an early uncivilised people.

Poetry, too, had the same origin, for the wild, almost incoherent, songs of these uncultivated people were the first attempts of human beings to give utterance to their feelings in language possessing a rudimentary kind of rhythm. Just as the rude outline drawings on bones and antlers preceded sculpture and painting, so the wild choruses of savage or semi-savage races preceded music and poetry.

In these low forms of Art we cannot trace any distinct individuality. They were collective, being of a uniform character, varying but slightly, and having no distinguishing mark. It is not till the highest forms of Art are reached that originality and individuality begin to manifest themselves. The early or collective forms of Art were used solely for the purposes of decoration and ornament. As ornament applied to persons, we find them in the tattooing of the body, in the wearing of nose and ear-rings; and in dress, from an idyllic arrangement of leaves to the highly complicated dress of some mighty official, extending to ten or a dozen different garments, serving to keep up the empty grandeur of some obsolete custom or ceremony. As decoration, we find it applied to inanimate objects, as pottery and other household utensils; to weapons of warfare; to the tombs in which the dead are buried; to the temples in which the living worship. Art has existed through many centuries, but it does not always display individuality. The houses of the poor, almost devoid of Art, display, perhaps, as much originality as the palaces of the rich; the hermit's cell as much as the great temples of religion; the Bible of the early persecuted Christians, hidden away in a rude box beneath the floor, as much as the elaborately printed volume, with its illuminated text, chained to its delicately wrought and polished eagle lectern.

It is not in elaborate display that individuality is to be found. It is in the quiet study, not in the noise of the fashionable world; in the poorly furnished studio, not in the princely mansion of the favourite of Society; in the orchard beneath the apple tree, or in the kitchen beside the boiling kettle, the genius produces for the world his great and individual work. It is not true progress of Art when its object has been to increase the splendour of some barbaric court, to add to the pomp of some powerful monarch. The highest Art does not serve for ornament alone, neither does it become subservient to the useful. It is for a far higher purpose than this, far higher even than to give delight merely. It is to raise the souls of all men of all time higher than the highest pinnacle they may have previously reached. It is to lift the thoughts from the contemplation of the mundane to the contemplation of the highest good, the great Ideal! This is the object of true Art: all other objects that it may have are necessarily insignificant when compared with it.

(To be continued.)

THE MIDDLE LIAS OF NORTHAMPTONSHIRE.

BY BEEBY THOMPSON, F.C.S., F.G.S.

(Continued from page 236.)

III.—Would the Water which goes in be Available for our Use?

I have had to refer, repeatedly, to objections urged against this water scheme; these, in many cases, I am pleased to say, had the sole object of eliciting explanations; but whether they had or not, the objections have been valuable to me in indicating the nature of the evidence desirable to offer in its favour.

In reference to the matter indicated by the above heading, it has been suggested by some that the area to be filled is so vast that the water would be almost as completely lost as if poured into the sea ; by others that the water would flow entirely away from the district, owing to the dip of the beds, forgetting that if it could, it would have done so years ago, and so left us without water.

It has been stated previously that the height to which water will rise in a well, its *artesian rest-level*, as it is called, is directly proportional to the height of intake, and inversely proportional to the resistance of the bed, where there is no intermediate relief of pressure. A local depression is always caused by local pumping, the extent of which varies with the porosity of the bed, and the pumping power. The difference in height of the artesian rest-level at different pumping stations gives the *artesian gradient*, and affords a measure of the resistance of the bed. Such being the case then, an equality of depression over a large area is a sign of extreme porosity.

There is scarcely a doubt that the continuous pumping of large quantities of water from the Marlstone, for the supply of Northampton, has been the main cause in reducing the water-level of the bed over a considerable area, say a sector of a circle having a radius of fifteen miles or more, because the amount extracted has been in excess of the natural intake in an equal time.

The importance of this consideration is, that it gives a good idea of the distance at which *feeding wells* may be constructed, for it is perfectly certain that if the pumping at Northampton has reduced the artesian rest-level over a certain area, that same area can again contribute any water which gets into it, whether naturally or artificially.

In 1881, the late Mr. Samuel Sharp contributed a paper to the "Journal of the Northamptonshire Natural History Society," entitled, "Some Remarks upon Local Wells and Borings, and upon the Consequences of Excessive and Indiscriminate Agricultural Drainage," in which he showed how the water-level of the county had fallen considerably. I cannot agree with his contention that it was due to excessive agricultural drainage ; indeed the remarks to follow will show conclusively that that is not the cause, but the facts he cites are quite relevant to the subject under discussion, hence I have incorporated them in the descriptions of wells below. The "now" refers to 1881, the date of Mr. Sharp's paper.

KINGSTHORPE SHAFT. When first made the water from the Marlstone rose to within 60ft. of the surface, *i.e.*, there was a head of 150ft at least.* No water now flows.

MR. BRETTEL'S FOUNDRY WELL, in Cow Lane, Northampton, was made about the same time as Kingsthorpe Shaft, and had a depth of 178ft. It was sunk 104ft., and bored 74ft., and the water rose to within 30ft. of the surface, thus giving a head-level of 140ft. Now dry. (No doubt this "head" would have been greater but that the water ran away into the Inferior Oolite, a kind of ragstone, as it is called in a report I have since seen.)

BARRACKS WELLS. Two wells were sunk in the Barracks yard many years ago, at least previous to 1847 ; the first had a total depth of 174ft. ; the second was sunk to a depth of 140ft., and bored to a further depth of 106ft., thus making a total depth of 246ft.

COUNTY JAIL WELL. This was sunk 102ft., and bored 72ft., making a total depth of 174ft.

The last three exhibited the same decline as Mr. Brettel's well, have been disused many years, and I believe filled up.

THE WATERWORKS WELLS. Three wells altogether have been made in close proximity to each other, near the Billing Road, in Northampton. The water rose at first from a depth of 168ft. to within about 70ft. of the surface, thus giving a "head" of over 90ft., but during the time pumping was continued, *i.e.*, from 1846 to 1885, this diminished till the water had to be extracted directly from the rock itself. After a period of rest of less than two years (1885—7) the water has again risen between 40ft. and 50ft., and probably would have risen higher but that it has been again used, as a supplementary town supply.

THE RESERVOIR WELL, on the Kettering Road, made only a few years ago, never yielded much water. I am not in possession of any particulars with respect to it.

KETTERING FURNACES WELL. This well was finished in 1878 ; it had a diameter of 6ft., and passed through 13ft. of Inferior Oolite, 157ft. of Upper Lias clay, and 14in. of Marlstone, a 5in. bore hole being carried a few feet lower. The water rose very little above the Rock-bed. Through the kindness of Mr. H. Sartoris, I am able to add that the water

* If my estimate of the depth of the Marlstone be accepted, this should be 213ft.

supply being unsatisfactory, the bore hole was plugged and an adit was made to the adjacent brook, perhaps some 50ft. lower than the surface of the well, the old well being used as a reservoir. The water-bearing rock is 119ft. above sea level, that is, 44ft. higher than at Northampton, but only 12ft. higher than at the Spinney Well. The well is now silted up to within 70ft. or 80ft. of the surface, hence I could obtain no information as to whether the Marlstone water had increased during the last two years.

THE WELL AT BERRY WOOD ASYLUM. A description of this well was given on page 235, so it will suffice here to record some recent observations. In 1885 there was a small supply of water, and special precautions were taken to prevent waste; nevertheless, the water sank till there was only 3ft. in the well. This year (1887) more water has been used necessarily than in 1885, no particular care has been exercised to prevent waste, and yet the lowest ascertained depth of water was 6ft. 3in. We should be well within the mark, I think, if we assumed that the water supply here had been doubled within the last two years. Berry Wood Asylum is about 3¼ miles W.N.W. of the Northampton well.

The particulars concerning these wells show—

1. *That the old wells yielded abundance of water when first made, but the amount continuously declined till* 1885, *the time of greatest depression at Northampton.*

2. *The newer wells, even when first made, never yielded much water, and one—the Spinney Well—none at all.*

3. *Coincidently with a rise of the water-level at Northampton, a rise has taken place some miles away.*

There is only one way of accounting for the increase of water at Berry Wood, and *it is not agricultural drainage that we have to look to;* in fact, this latter, as a cause affecting water supply, must take quite a secondary place.

Altogether it appears that the head-level of the Marlstone water within the Northampton district has sunk 150ft. to 200ft. within the last fifty years.

Some wells south of the Nen Valley have also been referred to, for instance, Brackley and Milton. These have a similar tale to tell—the water level has been gradually declining, though, as Mr. Sharpe points out with regard to Brackley, the decline is not so great. Mr. Sharp does not appear to have considered the great Nen "fault," or he would have probably seen that the results observed are consistent with. and only to be explained by, the draining of the northern Marlstone area by Northampton. The lowering of the water-level in the southern area is only due to extraction of water from a large number of smaller wells, many of which are situated on or near to the catchment area.

If, therefore, Northampton has exercised its power to obtain water from the Marlstone to such an extent that all other near sources, in certain directions, have been drained, by the continuous exercise of this power, and by keeping the water-level low, it would get the larger share of any water artificially put into it. I never could understand the mean and shortsighted opposition of some people to the filling up of the Marlstone, because other people would be benefited. Neglecting altogether any consideration for those who may, so far, have been debarred from getting water from the Marlstone, owing to our own monopoly of it, surely if we, at Northampton, could get all we want by this method, at less expense than by any other, we ought to be satisfied.

What I have been saying with regard to the draining of the Marlstone, of course, can only apply to the area westward of a line drawn through Northampton in the direction of strike of that formation, that is in a direction almost N.E. by S.W. It so happens that Kettering, Gayton, and Brackley, are situated almost exactly on this line, the first being 13 miles and the last 18 miles away. Making some allowance for curves in the strata, and resistance in the bed, one would expect to find the water-level at Kettering very low, as indeed it was. Eastward, however, of this line one would expect to find the Marlstone full, and the head-level of the water to increase most in a south-easterly direction. Fortunately I have been able to verify this, by finding a Marlstone spring at Raunds, nine miles S.E. of Kettering. This well, at a time when there was scarcely enough pressure at Northampton for the water to rise above the Rock-bed, and when there was very little water at Kettering in the same bed, had a "head" of nearly 60ft. of water. Considerable quantities of water were pumped from this well in 1884, for the supply of the village, but they could never reduce it more than two or three feet, and it rapidly regained its former level.

There are certain peculiarities with regard to this well which it would be of interest to investigate; but since it is situated some seventeen miles from Northampton, it could not have much influence on the Northampton area, and so I am content to simply give it as an illustration in support of the theory that in a certain direction the Marlstone has remained full, when in other directions it has been drained.

One great advantage that the scheme of water supply here discussed offers, is, that the artificial swallow holes will take in the drainage of districts where no conservation of water now takes place, owing to impervious beds occupying the surface, so it will practically enlarge the catchment area to a great extent. It does not matter where the water is put in, whether where the bed is now empty or where it is full, providing that in the latter case the water already present does not rise to the surface and the situation is not too far away from the pumping station to be supplied, because the water will tend to find its own level. I have placed a restriction as to distance, in the direction in which the bed is full, because the further away the opening the higher the natural "head" of water would be, and when only a few feet remained to be filled up the increased head obtained by filling up would have an insignificant result owing to resistance. On the whole it is fortunate that it should be so, for this same resistance, by producing an artesian gradient in the water-bearing bed, prevents the contingency of a well being opened sufficiently far to the south-east for the water to freely overflow, and so reduce the water-level in the whole bed to its own surface level. There is another good reason why this is not likely to occur, but as it depends upon data still to be considered, I have deferred giving it. It remains now for us to consider the storage capacity of the material of the bed, and the area to be filled, before we can arrive at any approximate idea of the time within which a satisfactory result might be anticipated.

(To be continued.)

HISTORY OF THE COUNTY BOTANY OF WORCESTER.

BY WM. MATHEWS, M.A.

(Continued from page 225.)

The Appendix to the "Midland Flora," forming Vol. III. of the work, was published in London in 1821. It introduces us to some new correspondents, and contains the following Worcester records :—

Fumaria (*Corydalis*) **solida**, 58. Abberley Woods. Mr. Hickman, surgeon, Ludlow.

Silene anglica, 37. Areley, near Stourport. Mrs. Gardner, late of Stourport.

Stellaria glauca, 36. Lickhill Lane, Worcestershire. Mr. Hickman.

* **Hypericum montanum**, 62. Blackstone Rock, near Bewdley. Perry.

Ulex nanus, 59. Astley Common. *This was doubtless U. Gallii Planch.*

* **Pyrus domestica**, 38. *Purton quotes the old authorities and some new ones for the occurrence of this tree in " Wire" Forest.*

Sium repens, 25. Bogs on the side of Abberley Hill; Cookhill, near Alcester. T. P. (*Thomas Purton*). *This is a variety of Sium* (Apium) *nodiflorum.*

* **Sium latifolium**, 26. Blakedown Pool, near Stourbridge. T. P.

* **Asperula cynanchica**, 14. Broadway Hills. Rufford.

Campanula rapunculoides, 18. Discovered by the Rev. G. H. Piercey, of Chaddesley, near Kidderminster, in a lane on a dry bank near to Shrawley Wood, September 30th, 1820.

Monotropa Hypopitys, 36. Shrawley Wood. Mrs. Gardner.

† **Melampyrum cristatum**, 54. Near Ombersley, Worcestershire. Mrs. Gardner. *Surely this must be an error.*

Myosotis versicolor, 16. On the top of Malvern Hill, nearly opposite the village. Rev. W. S. Rufford.

* **Cynoglossum sylvaticum**, 17. Near to Evesham on the Fladbury Road. Communicated by Edward Rudge, Esq., F.L.S., to Rev. W. S. Rufford.

Daphne Mezereum, 33. Eastham and Stanford, Worcestershire. Rev. Edward Whitehead, of Corpus College, Oxon.

Euphorbia platyphylla, 38. South Littleton.

Ceratophyllum demersum, 70. In fish ponds at W. Rawlins's, Esq., Brockencot, Worcestershire, filling nearly the whole of one pool.

Salix aurita, 76. On the Ridgeway. Common.

* **Acorus Calamus**, 31. On the banks of the Avon near Pershore, and at Hanley, Worcestershire. Rufford.

Potamogeton compressum, 16. In the ditches near Abbots Moreton.

P. compressum of Linnæus is represented by the four modern species—P. zosterifolius, P. acutifolius, P. obtusifolius, and P. mucronatus. P. zosterifolius and P. obtusifolius both occur in the county. Purton's plant was probably one of these.

Ophrys muscifera, 67. Eastham. Rev. Ed. Whitehead.

† **Scirpus carinatus**, 6. Chickhill Pool near Enville, and at Himley, Staffordshire; Scott, Stourbridge.

I assume the meaning of these records to be that the two Staffordshire localities were vouched by Mr. Scott, of Stourbridge. In " Stourbridge and its Vicinity" Scott refers the plants from these localities to S. lacustris.

Carex Œderi, 69. On the highest ground of Bromsgrove Lickey. *This must be the plant now known as Carex flava, var. minor.*

Avena pratensis, 13. Broadway Hills. Rufford.

* **Aira** (*Kœleria*) **cristata**, 8. Broadway Hills. Rufford.

* **Festuca Calamaria** (*F. sylvatica, Vill.*), 12. Communicated by Thomas Shrawley Vernon, Esq., who showed me a plant growing in his shrubbery, at Astley, near Stourport, Worcestershire, which he had removed the year before from the wood pointed out by the original discoverer, W. M. Moseley, Esq., of Winterdyne. Mr. Moseley informs me that he discovered Festuca Calamaria in Shrawley Wood in the year 1801, and sent a specimen to Dr. Smith for his inspection. He found it, not rare, in a particular part of the wood, though never producing a flowering stem, except where the coppice wood was recently cut and the plant exposed to the sun.

Aspidium Filix-fœmina, 79. Burcot, and the wet lanes near Bromsgrove Lickey. Very common. T. P.

27 plants are enumerated in the above list, of which 8 are previous records. From the residue of 19 we must further deduct Melampyrum cristatum as a probable error, Scirpus carinatus as a probable error and a Stafford record, and Potamogeton compressus as insufficiently identified. There remain 16 new County records to be credited to Purton's Appendix, 1821. Some of Purton's names of places require correction in spelling. "Spechley" is now usually spelt Spetchley, and "Headley's Cross" should be Headless Cross.

"A Description of Malvern," by Mary Southall, contains a list of "Plants growing at Malvern and in the neighbourhood." I have only seen the second edition, in which the list is printed at p. 215. The preface is dated August, 1825. The first edition was probably published a year or two earlier. The list contains 25 flowering plants. The majority of these are old records. The following are worth notice :—

Potentilla verna. Limestone rocks upon the western side of the hill. *Whether in Worcester or Hereford is not stated. This species is known as a Worcester plant at Wynd's Point on the eastern side, and as a Herefordshire plant on the western side of the hills. I fear the record belongs to Hereford.*

* **Orchis** *(Gymnadenia)* **conopsea.** Upon the western side of the hills.

Orchis ustulata. In meadows about the foot of the hills.

If we do not admit Potentilla verna, the list yields only Orchis ustulata as a new record. It still grows at West Malvern.

Mr. W. G. Perry, of Warwick, bookseller, the author of "*Plantæ Varvicenses Selectæ*," 1820, communicated to Loudon's Magazine of Natural History, Vol. IV., 1831, p. 450, a list of the rarer plants of Worcester. The list is dated Warwick, March 12, 1830, and is stated to contain only plants which were observed and gathered by himself in 1812, 1813, 1816, 1827, and 1829. The list is rich in records from the neighbourhoods of Kidderminster and Bewdley, and is worth printing entire, although it contains a large number of repetitions.

W. G. Perry, Mag. Nat. Hist., Vol. IV., 1831, p. 450—452.

Ranunculus hederaceus. In a swampy place on Abberley Hill, above the Hundred House.

* **Aquilegia vulgaris.** On the banks of Dowlass (*Dowles*) Brook, in Wire Forest.

Still one of the characteristic plants of the Forest.

* **Fumaria** (*Corydalis*) **lutea.** On a limestone wall near the church at Abberley.

* **F.** (*Corydalis*) **claviculata.** At Picket Rock near Kidderminster.

Picket or Pecket Rock is in Habberley Valley.

* **Turritis glabra.** (*Arabis perfoliata, Lam.*) Chester Lane, and in a lane near Crane's, of Habberley, Kidderminster ; and on the road side between Kidderminster and Chaddesley Corbet.

Nasturtium terrestre. (*N. palustre, D.C.*) On the banks of the Lodge Pools, Kidderminster.

Thlaspi arvense. In gardens near Broad Street, Kidderminster; and in fields near Hartlebury.

* **Teesdalia nudicaulis.** On Falling Sands Common.

* **Drosera rotundifolia.** In a swamp on the north side of Falling Sands Common, and at Devil's Spital-fields (*Spittleful*) near Kidderminster.

Polygala vulgaris, with white flowers, at Picket Rock near Kidderminster. *Probably P. depressa, Wend.*

* **Dianthus deltoides.** Blackstone Rock, near Bewdley.

* **Montia fontana.** In a swampy place on Abberley Hill, above the Hundred House.

* **Hypericum Androsæmum.** In a wood by Picket Rock near Kidderminster.

* **H. montanum.** Blackstone Rock, near Bewdley ; near a wood on Abberley Hill, west of Abberley Church ; and at Picket Rock near Kidderminster.

* **Malva moschata.** In a wood on the summit of Abberley Hill, west of Abberley Church ; and in hedges about Bewdley.

* **Linum usitatissimum.** In fields near Hartlebury.

* **Erodium maritimum.** On the heath at Picket Rock near Kidderminster.

* **Geranium lucidum.** Blackstone Rock near Bewdley.

G. columbinum. Road side toward Broadwaters, Kidderminster.

Trifolium striatum. At Picket Rock near Kidderminster, and on the side of the Kidderminster Road near Bewdley.

* **Ornithopus perpusillus.** Blackstone Rock near Bewdley, on Sutton Common near Kidderminster, and in fields between Kidderminster and Picket Rock.

Hedysarum Onobrychis. (*Onobrychis sativa.*) Near a wood on Abberley Hill, west of Abberley Church.

Vicia angustifolia. In a swamp on the north side of Falling Sands Common, Kidderminster; and in a field between Kidderminster and Picket Rock.

* **V. sylvatica.** In Wassal Wood, near Bewdley.

* **Potentilla argentea.** On the top of the rock at Foxholes, and on a rock by the road side at Wolverley near Kidderminster, and on rocks by the road side between Kidderminster and Bewdley.

* **Comarum palustre.** Oldfield near Ombersley.

* **Pyrus domestica.** In Wire Forest, June 25th, 1827. This solitary tree was observed by Mr. Pitts, in the time of Ray, and is supposed to be more than 250 years old. In the neighbourhood of the Forest it is well known by the name of the Witty pear. It appears to be rapidly decaying, as it bears leaves on the upper branches only, and shows no signs of fruit.

Rosa gracilis? In Wire Forest, near Pyrus domestica.

It is doubtful to what species this name is intended to refer.

* **Epilobium palustre.** On Falling Sands Common, Kidderminster.

E. roseum. In a garden before a house in Church Street, Kidderminster, 1816; and in Mr. John Lea's drying ground, Mill Street, Kidderminster, 1829.

* **Sedum dasyphyllum.** On a wall by the side of the Kidderminster Road, Bewdley.

* **Cotyledon Umbilicus.** On Picket Rock, and about Foxholes, near Kidderminster. Plentifully.

* **Sium repens.** In a swampy place on Abberley Hill, above the Hundred House.

Sambucus nigra, with laciniated leaves. Chester Lane, near Land Oak Turnpike, Kidderminster.

Galium saxatile. On all the heaths in the vicinity of Kidderminster.

* **Dipsacus pilosus.** Blackstone Rock near Bewdley.

Carduus acanthoides. In fields between Kidderminster and Picket Rock.

Cnicus (*Carduus*) **palustris,** with white flowers. At Picket Rock near Kidderminster.

* **Onopordum acanthoides.** At Summer Hill near Kidderminster.

Conyza squarrosa. (*Inula Conyza, D.C.*) In a lane near Hartlebury, and about Chaddesley Corbet.

Solidago virg-aurea. In Burnt Wood near Bewdley.

Prenanthes (*Lactuca*) **muralis.** Blackstone Rock and Rock Wood, near Bewdley; in a wood by Picket Rock, and Summer Hill, near Kidderminster; and Rock Hill, one mile and a-half from Bromsgrove, on the road to Alcester.

Hieracium murorum. In a wood by Picket Rock near Kidderminster, and in the Rocky Wood, Finny Rough, near Stone.

H. sylvaticum. (H. vulgatum, *Fries.*) Summer Hill, near Kidderminster; in a lane leading from Foxholes towards Kidderminster; and in Rock Wood, Burnt Wood, and Wassal Wood, near Bewdley.

* **Campanula patula.** In Dolphin Lane and in hedges, Chaddesley Corbet.

C. Trachelium. Blackstone Rock, near Bewdley; banks of the Severn near Stourport, and on a steep bank about four miles on the Hereford Road from Stourport.

* **Menyanthes trifoliata.** In a boggy field by Finny Rough near Stone.

* **Verbascum virgatum.** Near Worcester, on the road to Ombersley, 1813.

* **V. Blattaria.** Lanes about Foxholes near Kidderminster.

* **Antirrhinum majus.** Walls near the Cathedral, Worcester.

* **Linaria spuria.** In a hilly field at Hampton Magna, near Evesham.

* **Melampyrum pratense,** with orange flowers. In Wire Forest; in Rock Wood, and Burnt Wood, near Bewdley; and at Blackstone, near Bewdley.

Pedicularis palustris. Oldfield, near Ombersley; in Wire Forest; and in Burnt Wood, near Bewdley.

P. sylvatica. In a swamp on the north side of Falling Sands Common, Kidderminster; Oldfield, near Ombersley; and in high pastures at Trimpley Green, near Kidderminster.

* **Verbena officinalis.** In a lane near Hartlebury, on the Stone Cross at Stone; and between Dunley Hall and Abberley.

* **Thymus Calamintha** (*C. menthæfolia*). Hampton Magna, near Evesham.

Scutellaria minor. In Rock Wood, near Bewdley.

* **Marrubium vulgare.** Opposite to Crane's, of Habberley, on the side of the road leading to Picket Rock from Kidderminster.

Myosotis cæspitosa, with white flowers. In Burnt Wood, near Bewdley.

* **Symphytum officinale,** with purple flowers. On the banks of the canal, &c., Kidderminster.

Lysimachia nemorum. In a wood by Picket Rock, near Kidderminster.

* **Anagallis tenella.** In a boggy field by Finny Rough, near Stone. *Extinct in this locality.*

* **Rumex maritimus.** On the banks of the Lodge Pools, Kidderminster. 1816.

* **Juniperus communis.** In Wire Forest.

* **Triglochin palustre.** Finny Rough, near Stone.

* **Alisma ranunculoides.** Oldfield, near Ombersley.

* **Orchis** (*Gymnadenia*) **conopsea.** In a bog in Wire Forest.

* **Juncus squarrosus.** Devil's Spitalfields (*Spittleful*), near Kidderminster.

Scirpus sylvaticus. Near the Lodge Pool, Kidderminster, and in Wire Forest.

Eriophorum polystachion. In a bog in Wire Forest, and in a boggy field by Finny Rough, near Stone.

E. angustifolium. In a swamp on the north side of Falling Sands Common, Kidderminster; and in Burnt Wood, near Bewdley.

The two last are varieties of the same species. The Wire Forest Cotton Grass is E. latifolium. Hoppe.

Carex remota. In the Rocky Wood, Finny Rough, near Stone.

C. Pseudo-Cyperus. In the Lodge Pools, Kidderminster.

Melica uniflora. Blackstone Rock, near Bewdley.

* **Nardus stricta.** On Sutton Common, near Kidderminster.

* **Blechnum boreale.** At Foxholes, and on the Stourport Road, near the Larches, Kidderminster; Rock Wood, Burnt Wood, and Blackstone Rock, near Bewdley; in the Rocky Wood, Finny Rough, near Stone; and in a dingle between Dunley Hall and Abberley.

* **Asplenium Ruta-muraria.** On the church at Stone.

* **A. Trichomanes.** At Blackstone Rock, near Bewdley.

Aspidium spinulosum. In a cave on the right-hand side of the road from Kidderminster to Bewdley.

A. dilatatum. Blackstone Rock, near Bewdley.

* **A.** *(Athyrium)* **Filix fœmina**, with a scaly stalk. In the Rocky Wood, Finny Rough, near Stone.

Of the 80 plants enumerated in Perry's List, 32 only can be claimed as new to the county. There is a good deal of confusion in the nomenclature of places. Finney, otherwise Finny Rough, near Stone, so called by Perry, and still known to the country people as the Finney, is noted on the Ordnance map as "*Fenny Rough.*" The Parish of Abberley, near the Hundred House, is confused with Habberley, near Kidderminster, from which the H is omitted. It is in the middle of Habberley Valley that Pecket Rock is situated, miscalled by Perry *Picket* Rock. I have been unable to identify "Foxholes," a locality named very frequently by Perry.

(To be continued.)

Review.

Palæolithic Man in N.W. Middlesex. By Jno. Allen Brown, F.G.S., F.R.G.S., &c. Macmillan and Co., 1887.

This book of 200 pages, with plates in addition, consists mainly of a compilation from the author's reading; but contains also an account of some original investigations which, a year or two ago, excited some interest when presented in the form of papers to the Geologists' Association and Geological Society of London. It is almost needless to say that it is well got up by the publishers. The plates are good, many of them being from blocks lent by well-known authors of other works on the subject, and they give a very clear idea of the implements used by the palæolithic hunters and warriors.

The introduction gives a very fair, though not by any means full or lengthy, account of the archæological and geological remains of ancient man from various localities in Europe. Then we have a full account of "The Earliest Men of Ealing and its Neighbourhood; and the Physical Conditions indicated by the Drift Deposits in N.W. Middlesex." This part of the book, containing the original investigations of the author, appears to form the *raison d'être* of the whole; the introduction naturally leading up to it, and the sequel tending to explain and illustrate the facts here given. To many readers this sequel may prove highly interesting. It is entitled "A Consideration of the Conditions of Life presented by certain Savages apparently analogous to Palæolithic Men;" and contains a *résumé* of what is known of the manners and customs of many existing savage tribes and nations. Nor does the writer confine himself merely to facts, for in the body of the work (p. 60), he starts a curious speculation as to the existence of an island in the ancient Thames, which was the abode and secure retreat of some palæolithic men; and, in the conclusion, he gives a highly imaginative sketch of a palæolithic winter and spring.

Readers who wish a clear and concise narrative of the salient points in the evidence for human antiquity will find here what they require; for although the book cannot pretend to the completeness of larger works, it presents fairly the main conclusions which have been reached. We think the author is a little too much inclined to accept extreme conclusions on little or no evidence; as, for example, with respect to the human (?) fibula of the Victoria cave at Settle. This small fragment of bone, though at first considered to be human, after passing through a stage in which it was assigned to an elephant, is now almost universally admitted to have belonged to a bear. With this slight caution we can heartily commend the volume to those who desire to make themselves acquainted with the questions relating to the antiquity of man in Britain.

A word or two must be added concerning the original researches in the Ealing district. These bring out two points of importance. One is the extension of the valley gravels to a greater altitude than had previously been known, accompanied by the occurrence of rock fragments from the west and north of England, due presumably to ice transport. Indeed, the author goes so far as to attribute certain superficial furrows which he found to the grinding of icebergs; but in the discussion at the Geological Society, the glacial experts refused to admit the cogency of his reasoning as to the ice-origin of these furrows. The other point of importance is the discovery of a floor which had been a manufactory of palæolithic implements, for about 400 flakes and fragments, sharp and unabraded, were here found. Such floors have been discovered in other localities of the Thames valley by Messrs. Spurrell and Worthington Smith; but the point of interest in this floor is that the deposits are associated with foreign blocks traceable to the boulder drift. Thus Mr. Brown's discovery has an important bearing on the question whether, in the Thames valley, man was post-glacial or pre-glacial; a difference, however, which many will consider to be like the difference between "tweedle-dum and tweedle-dee."

G. D.

BOTANICAL NOTES FROM SOUTH BEDS,

WITH VOUCHER SPECIMENS FOR 1887.

Earliest observed Dates of Flowering.

Name.	Dates. 1885.*	Dates. 1886.*	Dates 1887.	Aspect, 1887.	Situation, &c.
Tussilago farfara......	Feb. 8	Mar. 3	Feb. 5	S.W.	Railway bank.
Corylus avellana	,, 1	Feb. 14	,, 6	N.E.	Hedge bank.
Poten. fragariastrum ..	Mar. 15	Apr. 4	,, 13	S.W.	Hedge bank, one blossom.
Mercurialis perennis ..	Jan. 4	Feb. 14	Mar. 13	N.E.	In 1887, inflorescences and foliage were noted Feb. 6, but no blossoms in the same station till March 13.
Petasites vulgaris	April 3	Apr. 7	Mar. 20	Open	Boggy meadow, several plants well open.
Ranunculus Ficaria ..	Mar. 8	Apr. 4	Mar. 20	Open	With the preceding
Salix caprea	,, 8	,, 4	,, 27	,,	Hill top.
Caltha palustris	,, 27	,, 4	Apr. 3	,,	Boggy meadow.
Cardamine hirsuta	,, 27	—	,, 3	S.W.	River bank.
Viola odorata	—	Apr. 4	,, 3	,,	Hedge bank.
Anemone nemorosa ..	Mar. 15	,, 4	,, 3	Open	Coppice.
Nepeta glechoma......	April 3	,, 23	,, 8	S.W.	Hedge bank.
Viola Riviniana	Mar. 29	—	,, 24	S.E.	Ditto.
Prunus spinosa........	Apr. 12	Apr. 23	,, 24	S.W.	Hedge.
Orchis mascula	May 5	May 16	May 7	Open	Coppice in Herts.
Scilla nutans	Apr. 25	—	,, 7	S.	Hedge bank.
Cardamine pratensis ..	,, 21	—	,, 7	Open	Meadow.
Stellaria holostea	,, 26	—	,, 7	S.W.	Hedge bank.
Ranunculus auricomus	,, 28	Apr. 23	,, 7	,,	Ditto.
Adoxa Moschatellina ..	Mar. 22	—	,, 7	,,	Ditto.
Geranium Robertianum	May 28	May 23	,, 29	S.	Ditto.
Cratægus monogyna ..	,, 17	,, 23	June 4	S.W.	Ditto.

* See "Midland Naturalist" for 1885 and 1886.

Leafing of Oak and Ash.

Oak trees were not in leaf till the last week in May, and ash trees till the first week in June. This is now the eighth season in which these two kinds of trees have maintained the same sequence in foliation, that is, in the districts of S. Beds. and N. Herts., where the observations have been made. There have been occasional exceptions owing to constitutional variations; sometimes a very vigorous ash tree may be as forward as a weakly oak; but it is no exaggeration to say that ninety-five per cent. of oak trees are in leaf earlier than the ash trees in the same situations. This statement does not take long to write, but the observations on which it is based are to be numbered by thousands, extending over the last eight seasons, and have been made in varied situations, and on different subsoils, as sand, clay, and chalk. The conviction has gradually been forced on one that the old adage was formed from insufficient data, and without allowing for constitutional differences, and dissimilarity of localities.

Pinguicula Vulgaris in South Beds.

The last edition of Watson's "Topographical Botany" makes no mention of this plant as occurring in Bedfordshire. It may, therefore, be worth recording that it has recently been found in two localities, one at Totternhoe, in a boggy meadow not far from the base of Totternhoe Knoll, where it is associated with *Parnassia palustris*, *Orchis latifolia*, *Carex binervis*, and the locally rare moss *Hypnum Sendtneri.* The other station is on the lower chalk escarpment, on the open hill side, but with a northerly aspect, and with a fringe of trees crowning the top of the hill above them, so that they are never exposed to the full heat of the sun. Pinguicula was first detected in this place by Mr. C. Crouch, whose eye was arrested by its blossoms as he was walking up the hill side, but with no thought of finding this plant in such a locality. The station is on one side of a large coombe, which has apparently been hollowed out by the action of springs, one of which still exists. The Pinguicula is here also associated with *Parnassia palustris*, and not far from it is *Carex binervis* by the side of the spring, and these plants are possibly the last lingering relics of a rich paludal flora that once occupied the base of the coombe when the springs were much higher than they are now. Both Pinguicula and Parnassia are abundant, but the former is limited to a narrow strip of the hill side, while the latter is distributed over a considerable area. It would seem that the Butterworts are dependent entirely upon the soil for their nitrogenous food, as one could detect no insects on the leaves, and the station is not favourable to the development of insect life, as it is decidedly cool. Have any other readers of the "Midland Naturalist" found these plants in similar localities?

James Saunders, Luton.

Wayside Notes.

We referred last month to the "Naturalists' Monthly," the first number of which was then about to be issued. The number contains an article on the "Pathology of the Celandine"—why the word "Pathology" is used, Mr. Friend, the writer, can probably tell us; a rather imaginative, but still thoughtful sketch describing the descent of the present-time salmon hook from the flint hook of prehistoric man; the first portion of each of "A Study in my Garden" (on Aphides), "Binary Suns," a "Biography of Charles Darwin" (with an engraved portrait, of which the moustache bears alone a close resemblance to reality), "Shell Collecting in Guernsey and Hern," "A Chapter on the Centipedes and Millipedes," and "The Origin and History of Fresh Water Faunas." Add to these numerous brief notes, reports of various societies, both metropolitan and provincial, and reviews, the whole occupying twenty pages of the size of the present "Gardeners' Chronicle," and our readers will see that a very copious bill of fare is offered. We heartily wish Dr. Williams success with his venture, but our faith is not strong. Happily for it, the Editor of the new "monthly" thinks differently, and already talks of an

"Editor's Easy Chair" when the periodical is enlarged. *We* can't afford an "Easy Chair;" to keep good, honest, but homely "Windsors" in sound repair is as much as we can hope for.

In the list of distinguished foreign botanists intending to be present at the British Association Meeting at Manchester, the name of Count von Solms Laubach was misprinted in our last month's "Notes."

"Some persons preserve roses during the whole of the year in the following manner: they take a number of rosebuds and fill with them a new earthen jar, and, after closing its mouth with mud so as to render it impervious to the air, bury it in the earth. Whenever they want a few roses they take out some of these buds, which they find unaltered, sprinkle a little water upon them, and leave them for a short time in the air, when they will open as if just gathered." This extract is from Lane's "Arabian Society in the Middle Ages," p. 163, and is given apparently on the authority of "Halbet-el-Kumeyt," a M.S. Arabian work of the fifteenth century. Can any reader of the "Midland Naturalist" furnish a commentary upon it?

Another point in the same work (p. 166), and given upon the same authority, is as follows:—"Another flower much admired and celebrated in the East is the gilliflower (menthoor or kheeree). There are three principal kinds; the most esteemed is the yellow, or gold-coloured, which has a delicious scent both by night and day; the next, the purple, and other dark kinds, which have a scent only in the night; the least esteemed, the white, which has no scent. The yellow gilliflower is an emblem of a neglected lover." Now the gilliflower, or gillyflower, of most people of the present day is the wallflower (*Cheiranthus Cheiri*), a flower which for many reasons is improbable. The stock (*Matthiola*) is likewise known by the same name to some folk, and would be a more likely plant. *M. odoratissima*, for example, is a Persian plant, with a flower becoming purplish brown when old, and which is very sweet scented in the evening. But the gillyflower of older English writers, down to Shakespeare's time, and that of South Europe as well, is the wild original of the carnation (*Dianthus Caryophyllus*). If any faith is to be placed in the fixity of the meanings of flowers, themselves probably of Persian or Arabian origin, there can be little doubt that this latter is the plant intended, for the deep red carnation has attached to it the meaning of "Alas! for my poor heart," the striped carnation, "Refusal," and the yellow carnation, "Disdain," all terms very closely allied to that attributed above to the "yellow gilliflower." By the way, according to the same dictionary of flower language, the gilliflower (undefined) implies "Bonds of affection," the stock "Lasting beauty," and the wallflower, "Fidelity in adversity."

This same Arabian authority gives highly respectable antiquity to the now-revived Narcissus cult. "The Narcissus," it says, "is very highly esteemed. Galen says, 'He who has two cakes of bread, let him dispose of one of them for some flowers of the Narcissus; for bread is the food of the body, and the Narcissus is the food of the soul.' Hippocrates gave a similar opinion." *Lilium viruptuum* is but a sample of *Galen redivivus*.

In the British Museum of Natural History, at South Kensington, a new geological gallery has just been opened to the public, which is specially devoted to collections illustrating geological types and the history of the science. Of these, four are of peculiar interest, the collections of Sloane, Brander, Smith, and the Sowerbys. The Sloane collection was purchased of Sir Hans Sloane so long ago as 1753, and is the most ancient of all the geological collections. The collection formed by Gustavus Brander, F.R.S., is of special value in that it is the earliest in which types of named and described species of fossils have been preserved, the descriptive account of them having been published in 1766. Dr. William Smith's collection, commenced about 1787, purchased in 1816, and subsequently extended, is remarkable as being the first collection in which a connection was shown between fossils and strata, *i.e.*, in which fossils were used in determining strata. Lastly, there is the collection made by the Sowerbys, father and son, and used in the preparation of their great work on the Mineral Conchology of Great Britain, published in parts between the years 1812 and 1845.

A Specimen of the Giant Puffball (*Lycoperdon giganteum*), more than deserving of its name, has been produced (mid-September) in a garden in Edgbaston. The monster was as nearly as possible globular, 37in. in circumference, and weighed, when at length gathered, 7lbs. 15oz. It grew in the midst of a clump of Michaelmas daisies, and when first discovered had attained 26in. circumference, and was taken by the gardener to be a stray fox terrier dog curled up in a comfortable berth. This puffball when young is edible, is indeed a great delicacy to mycophagists; its skin is of a delicate white kid-glove texture, and the interior likewise white; when old the interior becomes yellow, and the skin rougher and brownish.—W. H.

Examination Answers.—Below we give a specimen answer extracted from a paper, worked by one of the candidates in Geology, at this year's examinations of the Science and Art Department. As an example of "how not to do it," this attempt would not be easy to surpass. It is only fair, however, to say that such answers are the exception, and not the rule:—"The age of sedimentary rocks are known by their fossils. If you know the age of one rock you can easily tell the age of other rocks. You find fossils in the rock you don't know the age of. You then compare them with the fossils of the rock you know. If there are more fossils in the rock you don't know, of the same species of the rocks you do know, it must be newer. For there are more species of the same kind. If there are not so many species of the rocks you do know, the rocks must be older."

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—Biological Section, September 13. Mr. W. B. Grove in the chair. A number of specimens were exhibited by Mrs. Kent of unusually luxuriant galls on oak leaves, three species being represented in some cases on one leaf. Mr. Walliker exhibited a collection of mosses, lichens, and hepaticæ that he had found in Norway, including *Racomitrium lanuginosum*, *Tortula tortuosa*, *Ulota Bruchii*, and *Parmelia perlata*; Mr. Wilkinson exhibited *Medicago sativa* from Stratford-on-Avon, *Atropa Belladonna* (Deadly Nightshade) with its seeds under the microscope, and some grasses from Dudley Castle; Mr. Grove exhibited the following fungi from the Rhine:—*Phyllosticta cruenta*, *P. scrophulariæ*, *Septoria saponariæ*, *S. rubi*, *Ramularia arvensis*, *Camarosporium robiniæ*, *Asteroma reticulatum*, and *Xylaria polymorpha*; Mr. Marshall exhibited some microscope objects from the Puffin Island dredging expedition of the British Association. Professor Harrison, of Barbadoes, presented to the Society, through Mr. Alleyn, of Bristol, a box of microscope slides of Polycystina and Diatomaceæ collected in Barbadoes.

Mr. Grove presented a monograph on the Gold Wasps of Germany. Mr. W. J. Morley presented a large microscopic slide cabinet as a memorial of his late brother, Mr. John Morley, so many years the Honorary Secretary of the Society.—GEOLOGICAL SECTION, September 20. Mr. T. H. Waller, B.A. B.Sc., in the chair. Exhibits:—Mr. W. B. Grove, B.A., magnificent specimens of *Agaricus muscarius*, also *Phallus impudicus* in fulness of growth and smell, from HopwasWood, Tamworth (for Mr. Clarson); also *Agaricus fusipes*, and *Mucor fusiger* parasitic thereon, from Bedford (for Mr. Hamson); also a specimen of pumice from the Eifel. Mr. C. R. Robinson, *Coprinus comatus*, grown in Elvetham Road; appears regularly in same place each year. Mr. Waller, a curious fasciated lily. Mr. J. E. Bagnall (for Miss Taunton), an interesting series of plants collected during a recent visit to Sicily, including Eucalyptus, Asphodelus, and *Olea europœa*. Mr. Bolton, *Ceratophyllum demersum* in fruit. Mr. Walliker, *Cetraria Islandica*, and flexible limestone from Marsden quarries.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—July 18th, Mr. Barradale exhibited specimens of dragon flies from North China; Mr. J. Madison, specimens of *Helix thyroides*, *H. solitaria*, *H. profunda*, *H. palliata*, *Planorbis campanulatus*, and other land and freshwater shells from Ohio. Mr. Rodgers, *Volvox globator*. Mr. J. W. Neville then read a paper on "The Honey Bee," a practical study. The subject was treated under three heads: first, the honey bee and its work; secondly, its structure; and thirdly, its special modifications. The writer said this insect had received so large a share of attention that little new matter remained to be said under the first head; still, many questions suggested themselves that were difficult to answer. Why should honey bees have so far outstripped other insects in the race of life? What advantages do they gain from a social life? What first induced such a change, most probably from a solitary habit? How did bees first lose their sexuality, and what caused it to be transferred to a queen or mother bee? The structure of bees was next dealt with at some length. Under the third head the writer described some of the singular modifications of the large family of bees, and traced them back to a probable normal form not widely different from the present wasp, and showed how, by a series of gradations, the high development of the hive bee was reached. The paper was illustrated by a series of microscopical preparations.—July 25th, Mr. H. Hawkes exhibited a male specimen of *Dicranura vinula*; Mr. J. Madison, specimens of *Valvata tricarinata*, *Ancylus tardus*, *Planorbis deflectus*, *Vertigo ovata*, *Pupa contracta*, and *Helix pulchella*, all from the United States. Under the microscopes Mr. Moore exhibited gizzard of cockroach; Mr. Hawkes, pollen of *Œnothera biennis*; Mr. Rodgers, caddis worms just hatched.—August 8th, Mr. J. Madison showed specimens of *Planorbis parvus* from Packington Park, and *P. nautileus* from Scarborough; Mr. Corbet, leaf and polished specimen of wood of tulip tree.—August 15th, Mr. Moore exhibited under the microscope the gizzard of *Dytiscus marginalis*; Mr. J. W. Neville, water net, *Hydrodictyon utriculatum*; Mr. J. A. Grew, Protococcus in its resting stage.—August 22nd. Mr. J. Madison exhibited specimens of *Alcyonella fungosa*; Mr. Wagstaff, a rare caddis worm, *Oxythira cottalis*. Mr. Corbet then read a paper "On and Around Snowdon." The ramble was made early in the year, when the range was about half covered with snow. The writer described the ascent from Capel Curig by the Copper Mine to the summit; the difficulties, even through the snow, being more imaginary than real. The view from the cairn was very fine, though far more limited than the view of the guide-books. The descent was made by Llanberis, where the glacier-scooped valleys, striations, moraines, and erratic blocks were described as furnishing a five-mile walk of surpassing interest to the geologist. The paper was illustrated by photographs and collections of rocks, shells, &c., gathered by the way.—August 29th. A general exhibition, friends being invited. The specimens comprised collections of British birds, birds' eggs and nests, British and foreign insects, fossils of the Carboniferous period, caddis cases, land shells, dried plants, microscopic fungi, and a series of objects under the microscopes. The meeting was well attended, and the interest shown by the visitors in the different objects made it an instructive and enjoyable evening.—September 5th. Mr. J. Madison exhibited specimens of *Helix rufescens*, var. *rubescens*, from Edge Hill; Mr. Deakin, eggs of quail, *Coturnix vulgaris*. Under the microscope, Mr. H. Hawkes showed a slide of five pollens; Mr. J. W. Neville, auditory organs of grasshopper. Mr. H. Insley then read a paper contributed by Mr. C. F. Beale, on "A Visit to the Ordovician Rocks of the Corndon District." The paper described a ramble from Montgomery to Warrington Dingle, through Chirbury. An exposure of the Whiltery ash was first met with, where a few graptolites were found. The Aldress shales yielded a few fossils; by following the Spybrook for some distance the Spyburn grit was reached, which yielded some splendid fossils, notably some very large specimens of *Berychia complicata*. The Middleton beds, Corndon beds, and Weston grits were explored, and a good number of specimens secured.—September 12th. A paper was read by Mr. Armstrong on "Volcanoes." The writer said the subject of the paper had been enveloped in mystery and superstition from the earliest ages, but the advances of science had stripped it of its supernatural elements. The paper dealt with the different kinds of volcanoes, their number and uses, and described the more important products ejected from them, concluding by pointing out to how great an extent the beauty of English scenery was owing to volcanic agency. The paper was largely illustrated by diagrams.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY. —SECTION D, ZOOLOGY AND BOTANY. Evening Meeting, September 21st. Attendance twelve (three ladies). Mr. F. T. Mott in the chair, in the absence of Dr. Tomkins, chairman. Exhibits:—By Rev. T. A. Preston, white variety of *Viola Riviniana* in flower, and growing plants of *Astrantia major* for distribution. By Mr. T. Palmer, fronds of *Nephrodium Thelypteris* from Norfolk. By Mr. F. T. Mott, dried specimens of *Asplenium viride* from the Craven Hills, Yorks., for distribution. Mr. Mott presented reports upon the publication of the "Flora of Leicestershire," showing the cost of publication and advertising, and the number of copies sold; also on Mr. Bates's collection of 1,700 microscopic slides of the Freshwater Algæ of the county, purchased by the Society; also copies of the report of the Corresponding Societies' Committee to the British Association, giving a Catalogue of Papers published in the Transactions of the various Local Societies for the past twelve months, thirteen papers read in the Sections of the Leicester Literary and Philosophical Society being mentioned; and of the report of the Provincial Museums' Committee of the Association, giving particulars of 211 museums in the British Islands, exclusive of those in London. The chairman then read a short paper on "The Songs of some Leicestershire Birds," showing that there were about thirty species of singing birds known in the county, and giving particulars of the songs of twenty with which he was most familiar.

SOME INVESTIGATIONS INTO THE FUNCTION OF TANNIN IN THE VEGETABLE KINGDOM.

BY W. HILLHOUSE, M.A., F.L.S. (PRESIDENT).*

In working, during the winter of 1882-3, upon the question of the movements of food-substances in the plant during the period when the chlorophyll-function is not being carried on, I was much impressed by the wide distribution and often abundant presence of that variable body known generically as tannin. It seemed to me to be hardly credible that a body so prevalent in vegetable growth should have no direct relations of utility to the plant. My attention being thus directed to the matter, I endeavoured during the ensuing summer to carry on, in the intervals of other work, a few investigations into the relations of tannin with plant life, which are here recorded, the temporary loss of the manuscript through a domestic removal being almost wholly responsible for the delay in publication.

In the large series of bodies, which, from their capability of resolution by boiling with dilute acids or alkalies, or by the action upon them of ferments, into a glucose and one or more other compounds, are grouped together under the generic name of *Glucosides*, there is none which approaches, whether in economic importance, universality of distribution, or physiological interest, to the group of the tannins, or, as I shall hereafter as a rule speak of them, to tannin.

General Chemistry.—In all its forms tannin is characterised by a weak acid reaction, and an easily recognisable astringent taste. As obtained, it forms a shining amorphous powdery mass, freely soluble in water and alcohol, producing characteristic reactions with ferric salts, precipitating a solution of gelatine or albumin, and uniting with animal membrane so as to produce a substance (leather) which is capable of resisting decomposition. This latter property is the scientific basis of the process of tanning.

Although we shall find it convenient hereafter to speak of the group under a single name, it must be borne in mind that the name includes a considerable series of bodies, of slightly varying character, and our knowledge of which is still extremely limited. Most of them appear to be glucosides of gallic acid, and capable of resolution into gallic acid

* Transactions of the Birmingham Natural History and Microscopical Society, Biological Section, June 14th, 1887.

and glucose; those which give the blue-black reaction with ferric salts as a rule yield pyrogallol ($C_6 H_3 (OH) 3$), which gives with ferrous salts a blue-black, with ferric salts a red colour; while those which give the iron-green reaction commonly yield pyrocatechin ($C_6 H_4 (OH) 2$), which gives with ferric chloride a dark green colour. The blue reaction with iron salts, a reaction which lies at the basis of the manufacture of ink, is by far the more prevalent amongst tannins. In the tannins known as Kino and Catechu, and in the tannins obtained from the leaves of the tea-plant and the twigs, &c. of the Sumach, are examples which produce the green reaction with the same salts.

The most important form of tannin, gallotannic acid, is especially abundant in the gall-nuts of *Quercus infectoria*, and other species, in the common oak apple, and many other parts, and gives a typical example of the power of resolution into glucose and gallic acid, being, however, most probably first resolved into glucose and tannic acid, and this latter then converted into gallic acid. It is, however, probable that gallotannic acid, when quite pure, is not a glucoside, but directly consists of digallic acid.* As gallotannic acid is the only form in which tannin has been at all carefully investigated, and even this with the difficulties indicated in the foot-note, it is clear that nothing of importance can be said of the various other forms of tannin recognised, on more or less valid grounds, by the chemist. Two conclusions we are however justified in drawing. These are (1) that tannin is richer in carbon and oxygen than are carbohydrates, and (2)

* There is marked confusion in the chemical mind as to the exact nature of the body in question, and the cause is not difficult to recognise. All the solvents used for the extraction of tannin are likewise solvents, amongst other things, of glucose, which probably in all cases is present in the tissue. Hence, the tannin extracted contains free glucose which cannot be separated from the tannin itself. It will be seen that this fact likewise affects all experimental investigations into the growth of fungi, &c., in solutions of tannin. When the chemist has found some way of separating glucose from tannin, a more perfect appreciation of the constitution of tannin will exist. The ordinarily accepted formula is

$$C_{14} H_{10} O_9 = C_6 H_2 (OH)_3 \cdot CO \cdot O \cdot C_6 H_2 (OH)_2 \cdot CO_2 H.$$

Another formula illustrates the relations between tannin and gallic acid thus:—

$$C_{14} H_{10} O_9 \text{ (tannin)} + H_2 O = 2\, C_7 H_6 O_5 \text{ (gallic acid)}.$$

Strecker, who worked very largely at tannin, gave as his earlier formula $C_{27} H_{22} O_{17}$. He now accepts the formula $C_{14} H_{10} O_9$ for tannic acid or tannin, and considers it as probably the first etherial anhydride of gallic acid, using the lengthy composition formula given above.

that either free, or in comparatively loose combination with it in the vegetable tissues, is an uncertain percentage of glucose. This latter may, in part at least, account on the one hand for the possibility of growing to some small extent moulds in solution of tannin, and, on the other hand, for the fact that solutions of tannin can be readily decomposed by means of moulds or bacteria into sugar (glucose) and gallic acid, and, it is said, under certain circumstances even further. Schiff's formula for this decomposition by a ferment is

(*a*) $C_{34}H_{28}O_{22} + 2H_2O = C_6H_{12}O_6$ (glucose) $+ 2C_{14}H_{10}O_9$ (tannic acid).

(*b*) $C_{14}H_{10}O_9 + H_2O = 2C_7H_6O_5$ (gallic acid).

Schiff is stated to have obtained tannic acid free from the glucose above referred to by a process consisting essentially in acting upon tannin, as extracted, by means of oxychloride of phosphorus, but this I take the liberty of very strongly doubting.

Micro - chemistry. — The botanist who works out the chemistry of the cell-contents under the microscope is far more restricted in his power of producing chemical reactions than is the ordinary laboratory chemist. Any changes produced by his reagents must be clearly optically recognisable, and hence, as a rule, he is confined to reagents which produce colour reactions, or changes of form (*e.g.*, by swelling), or which act as solvents. Thus, many of the metals, such as antimony, lead, barium, strontium, &c., produce tannin reactions which the macro-chemist can work upon, but a white precipitate is for micro-purposes useless, owing to the difficulty of recognising it. The most time-honoured reagent for tannin is a salt of iron, a reaction known even to Pliny.* The salts most commonly in use are chloride, acetate, and sulphate, but others have been recommended from time to time. With any of these tannin takes either a green or blue colour, giving rise to the customary classification of the tannins into iron-blue or iron-green. The main micro-chemical utility of iron-salts as reagents for tannin lies however in their indicating which of these two groups is present; otherwise they have several distinct disadvantages. The most important of these is that they indicate presence but not position. The solution of tannin diffuses so readily and rapidly that the

* "Die sehr characterische Reaktion eines Galläpfeldekokts mit Eisen war schon Plinius bekannt, und wurde in Alterthum verwendet um Verfalschungen des Grünspans mit Eisenvitriol zu entdecken. Es ist dies überhaupt die allererste chemische Reaktion." Müller's Poulsen's "Botanische Mikrochemie," 1881, p. 69.—Adulteration is no modern device of those who make haste to grow rich. It is probably as old as trade itself.

coloration of the contents of a cell is no proof that those cells in their uninjured state contained tannin. Further, all these salts, and especially the chloride, are uncertain. I used German preparations of "Eisenchlorid," or of "Schwefelsaures Eisenoxydul,"* in all of the observations hereafter detailed, as a preliminary, in order to test the nature of the tannin present. I took all the customary precautions, but sometimes my notes were "no tannin," when the subsequent use of another salt, or of potassium bichromate showed it distributed widely, if not plentifully. I cannot, therefore, agree entirely with Nägeli,† when, speaking of the reactions of the iron oxide salts, he says "Diese Farben treten . . . in so intensiven Tönen hervor, dass sie der Jodreaction auf Stärke an Sicherheit und Zulässigkeit kaum nachstehen." Perhaps in another sense of the comparison I can however coincide, since I have already shown ‡ that very frequently the iodine reaction for starch is unreliable, unless the reagent be decidedly aqueous.

Sanio has recorded still another general objection. "Gerbsaures Eisenoxyd ist in überschussigen Eisenchlorid löslich." § Take a section of gall apple in water; add one drop of iron chloride and you have a dark-blue precipitate; add iron chloride to excess, the precipitate dissolves to a greenish yellow, or, if much precipitate be present, to an olive-green clear fluid.

The same author had previously ‖ recommended the use of dilute iodized chloride of zinc (Chlorzinc iodine, Schultz's solution), by which tannin is coloured rose-red to violet. The same general objection of easy diffusibility applies equally to this reaction, with the additional one that the cell walls and any starch contents of the cells are alike coloured from red to violet, thus adding an element of confusion, especially in the case of researches like the present, where the presence of starch in the same cells with the tannin is an important feature.

* This latter I have found by far the more certain.

† *Nägeli und Schwendener*, "Das Mikroskop," 2te Auflage, 1887, p. 490. Further on (p. 491), speaking of Sanio's Potassium bichromate reaction, he says, "Wir haben dieses Verfahren selbst nicht geprüft (!), doch scheint uns die Behandlung frischer Schnitte mit Eisenchlorid wenigstens für saftige Gewebe den Vorzug zu verdienen." This, after Sanio's reaction had been in use for 14 years; and the preference, too, is given to the salt of iron which, of all those in general use, is the most uncertain.

‡ "Proceedings of the Camb. Phil. Soc.," 1883, p. 400, 402.

§ *Sanio*, "Einige Bemerkungen ü. den Gerbstoff ü. seine Verbreitung bei den Holzpflanzen." Bot. Zeit., 1863.

‖ *Sanio*, Bot. Zeitung, 1860, p. 213.

By Hanstein* aniline violet has been used, colouring tannin fox-red. I have similarly used fuchsine, by which (after passing the sections through dilute sulphuric acid) tannin contents of the cells are coloured purplish red, the colour being retained for some months.

Kraus † has suggested that tannin may be recognised by means of its relations with glycerine, under the influence of which it forms drops which later disappear. In this, however, it is not recognisable from glucose, which reacts in the same way.

The reagent which is used in the bulk of the following experiments, and in all those which I considered crucial or upon which I have founded any conclusions, is a watery solution of potassium bichromate, first recommended by Sanio.‡ When portions of the tissue to be examined are laid for from two to seven days in this fluid, the tannin contents of the cells form with the reagent a compact moderately dark-brown gelatinous mass, either in one lump filling the cell, or in several lumps or balls of various sizes; or, if only a trace of tannin be present, a few reddish small granules. This compound is insoluble, and sections of the tissue (rejecting the external ones) can be cut and preserved as preparations for at least two years or so, showing definitely both the position and the quantity of the tannin, though not showing to which of the tannin groups the particular one belongs. It is quite true that certain other cell contents are liable to reduce bichromate of potash, and produce a colour reaction; the tannin reaction is, however, distinguished more even by form and appearance than by colour, and no one with experience is likely to go astray.

I have found that osmic acid also is (in one per cent. solution) a reagent for tannin. The solution turns black by reduction. Provided the cells are unbroken, this colour reaction can also be preserved, but unfortunately certain other cell contents reduce osmic acid, and discrimination is not always easy.

Distribution.—This will be specially considered hereafter.

Function.—As to the part which tannin plays in the metabolism of the plant, the opinions of observers have widely differed.

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* *Hanstein*, Bot. Zeitung, 1868.

† *Kraus*, "Ueber das Verhalten des Zuckersaftes der Zellen gegen Alcohol und Glycerin, u. s. w." Stzb. d. Naturforsch. Ges. zu Halle, 1876 (Bot. Zeit., 1876, p. 644).

‡ *Sanio*, l. c. Bot. Zeit., 1863.

Sachs,* in his researches into the germination of *Phaseolus multiflorus* (the scarlet-runner kidney bean) says, "Den leicht beweglichen Kohlenhydraten und Eiweissstoffen gegenüber bilden der Gerbstoff und die Farbstoffe eine Gruppe träger Elemente, da sie, wo sie einmal entstanden sind, liegen bleiben. Diese beiden Gruppen sind in der That physiologisch in jeder Hinsicht verschieden; Kohlenhydrate und Eiweissstoffe sind in ruhenden Keim vorhanden, sie sind nicht das erste, sondern das letzte Assimilationsprodukt der Mutterpflanze, ein fur Nachkommen aufgespartes Capital; Gerbstoffe und Farbstoffe dagegen treten auf an den Stellen wo die Vegetation beginnt, wo jene Assimilationsprodukte der Mutterpflanze nur in neue Form übergehen. Der Gerbstoff, und der mit ihm in denselben Zellen enthaltene Farbstoff scheinen Nebenprodukte des Chemismus in producirenden Gewebe."† This sentence is the foundation of the views of one body of vegetable physiologists, that tannin is a bye-product of assimilation. In this connection it ought, however, to be pointed out that the tannin of *Phaseolus* is, in many respects, quite unlike the tannins so commonly met with in the cortex, &c. of woody plants.

Wigand‡ believed that tannin forms an essential factor in the chemical processes of plant life, and always physiologically as a member of the series of carbohydrates. Always appearing in opposition to starch, it in general seems to play a part in the series of materials possessing formative energy, though in some cases it also acts as a reserve material. Nothing could be more diametrically opposed to the view of Sachs than this.

Wagner§ endeavoured to distinguish a pathological from a physiological tannin, based on their varying relations to ferments and dilute acids; but it is not apparent that he intended by his choice of classificatory terms to convey any idea of the physiological significance of tannin to the plant.

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* *Sachs*, "Ueber die Keimung von Phaseolus multiflorus;" Sitz. der Wien. Akad., 1859, pp. 57, et seq.

† The gist of this sentence is that the carbohydrates and albumins on the one hand, and the tannins and colour bodies on the other, are physiologically opposites. The former are products of the mother plant stored within the seed; the latter appear with renewed growth, simultaneously with the chemical changes in the stored food materials, and are probably, therefore, bye-products of these changes.

‡ *Wigand*, "Einige Sätze ü. d. physiologische Bedeutung des Gerbstoffes und der Pflanzenfarben"; Bot. Zeit., 1862, pp. 121-5.

§ *Wagner*, "Beiträge zur Kenntniss u. s. w. der Gerbsäuren," Journ. f. Prakt. Chemie., Bd. 99, 1866, pp. 294-305.

Wiesner* believed that tannin is an intermediate member between the carbohydrates, starch cellulose, &c., and resin.

Sachsse " ist sogar geneigt, die Gerbsäure als eine Uebergangsbildung der Stärke in Cellulose, anzunehmen, da diesen Uebergang immer unter Entwickelung von Kohlensäure stattfindet, und von den Auftreten an Gerbstoffen begleitet ist." †

Hartig ‡ believed that tannin remained in the oak through the winter in the form of grains, very similar to starch grains. He called this "Gerbmehl," distinguished from starch by its solubility in cold water, and its reactions with iron.

Schell, § in the most extended researches into the distribution and function of tannin which have been published, arrives at the conclusion that in some cases tannin is a bye-product of metabolism, in others an actual constructive material. He comes to this latter conclusion from its disappearance and subsequent reappearance during growth. In the germination of some oily seeds, *e.g.*, *Cynoglossum vulgare*, *Anchusa officinalis*, *Asperugo procumbens*, *Symphytum echinatum*, *Echium vulgare*, the tannin begins to serve as a constructive material with the disappearance of the oil, and then diminishes in quantity; in all other cases, when the plant presents much oil or starch, and these do not disappear, the tannin is laid by as a bye-product. In the stem, amongst others, where it is present in some quantity during winter, it mainly disappears in spring. Schell believes in general that tannin acts as a constructive material only when the carbohydrates, oil and starch (? and sugar), are present in small quantities or are wanting; the same occurring when plants (*e.g.*, *Faba vulgaris*) are germinated in unfavourable circumstances, as in pure sand.

Th. Hartig in his more recent publications || adheres to his old opinion on the nature and function of "Gerbmehl,"

* See *Wiesner*, Bot. Zeit., 1862, pp. 389-394, for further views on the relations between tannin and colours.

† *Sachsse*, in "Ebermayer's Physiologische Chemie der Pflanzen," p. 412, is disposed to consider tannin to be a transition product from starch into cellulose, as this change always takes place with evolution of carbonic acid gas, and is accompanied by the appearance of tannin.

‡ *Hartig*, "Ueber den Gerbstoff der Eiche," Stuttgart, 1869; see also Bot. Zeitung, 1865, pp. 53 and 237.

§ *Schell*. I am acquainted with this paper only in the form of an abstract, "Physiologische Rolle der Gerbsäure," in Bot. Jahresbericht, 1875, pp. 872—8. The original is in Russian, 136 pp. quarto, with two plates, 1874.

|| *Hartig*, Anatomie und Physiologie der Holzpflanzen, 1878, pp. 119-123; "Das Gerbmehl."

resubstantiates his earlier statements on the storage of tannin in the form of grains in the winter food reservoirs of plants (*e.g.*, the oak), and its solution in the spring sap. He sums up his opinions thus:—"Die physiologische Bedeutung des Gerbmehls ist dieselbe wie die aller übrigen Reservestoffe. Es wird in Frühjahrsafte der Bäume aufgelöst, ohne seine Reaktion auf Eisensalzlösungen dadurch einzubüssen, im Sommer und Herbste jeden Falles in den zugewachsenen Baumtheilen neugebildet. Was und wie viel vom Gerbmehlgehalt der Bäume im Winter, auf Neubildung von Zellen im darauf folgenden Jahre verwendet wird, welche veränderungen die Gerbmehllösungen hierbei erleidet, ob der Gerbsäuregehalt des Gerbmehles hierbei betheiligt ist, dafür fehlt mir zur Zeit noch eine lange Reihe nothwendiger Ermittelungen." (l.c. p. 123).

So far for experimental evidence, and now for two opinions expressed upon the evidence afforded by others.

De Bary* thus expresses himself on the subject:—"It is true that the abundant presence of this body, tannin, in secretory sacs is not decisive, since it exists also elsewhere, in the epidermal cells, and in many, especially ligneous, plants, and particularly in the assimilating starch-forming parenchyma, and, as far as we know at present, it is at least undecided whether it exists here as a bye-product in constructive metabolism, as is the case with calcium oxalate, or is a definite transition phase therein."

Sachs† says:—"Very widely distributed further are certain tannins, often mixed with a red colouring matter, and which are either present in special isolated cells, or in rows of cells, without being again used in metabolism, which therefore are to be considered as excreta. In other cases, on the other hand (*e.g.*, the germ shoot of the oak), there are tannins of another kind which, by their origin and disappearance and by their behaviour in growth, are to be recognised as special forms of reserve food-material, which find further use in metabolism . . . ."

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* *De Bary*, Vergleichenden Anatomie, p. 160. Some further references to literature will be found here, and also in *Nägeli u. Schwendener*, l.c., and *Pfeffer*, Pflanzen-Physiologie, i., 305-6.

† *Sachs*, Vorlesungen über Pflanzenphysiologie, 1882, p. 209.

(To be continued.)

INDIVIDUALISM IN ART.

W. KINETON PARKES.

(Continued from page 250.)

If we trace the history of the opera, we shall see how individualism gradually asserted itself.

Opera is the blending of three arts, the art of acting, of music, and of poetry. It originated in the application of recitative to recitation. Recitative was in the beginning all the music that was used in opera, if it can be called opera at that stage. This in time gave place to concerted music: choruses, part-songs, and solos alternated with the recitatives, and dialogue became entirely eliminated. From being a play in its function it became one of the best forms of musical expression, and it is now, with oratorio, the highest form of musical art in which poetry is employed. The history of opera is one of the most striking examples of the development and progress of an art. "Transformation of the homogeneous into the heterogeneous," we know, "is that in which progress essentially consists," * and this is exemplified in the evolution of the opera as it is in all the products of human thought and action. From the simple homogeneous productions of unknown men, we see opera in our time evolved into the complex, heterogeneous production of several great men. For the successful performance of primitive opera little was required, but see the numberless things that have to be combined for the performance of a great modern opera in which the individuality of those whose genius has produced it must be displayed. The instrumental music is composed by a great musician in such a way that it entails a large and varied orchestra; the vocal parts are written so that none but the most highly trained singers can sing them. The music is ingeniously wrought into harmony with the words of the poet, and the whole must be interpreted by the genius of the actor-singer. Take Gounod's "Faust:" there is the wonderful individuality of the composer; there is the glorious individuality of Goethe; and to interpret these great masters we must have such men as Signor Foli and Maas; such women as Mdme. Patti and Mdme. Nilsson.

In the realm of pure sensuous music we may instance the great and vivid individuality of Wagner. With him, everything is in harmony with the music; the acting is that

* Herbert Spencer. Essay on "Progress."

which is suggested by the fervour, fire, and fascination of it. But sound is the really important factor, to the exclusion of every other motion or emotion, to be taken into account in a consideration of this composer's work. He, more than any previous master, insists that the surroundings shall be in accordance with the music; insists that the scenic effects shall be good, the poetry good, and the acting and singing good. He, more than anyone, so wrote his operas that the music should wholly accord with the demands of the situation, the poetry, and the action. It is in this that his individuality consists; it is this that will cause him to be remembered for all times as the originator of a school of music which satisfies this analytic age.

As is the case with music, so has the progress of all the arts been. A change from the homogeneous to the heterogeneous, from the tom-toms of the savage to the glorious compositions of Wagner, Gounod, Sullivan. From the drawings of the cave men to the Elgin marbles; to the work of Michael Angelo, Raphael, Titian, or Dante Gabriel Rossetti, Holman Hunt, and Burne Jones. From the old, old unwritten ballads to the epics of Homer and Dante, from the ancient bards to Shakspere and Shelley. From the early chroniclers to Goethe and Carlyle. From the alchemists and their elixir of life to Galileo, Newton, and Darwin. And this progress of Art has taken place contemporaneously with the development of individuality; and the greater the rate of the progress the more pronounced has been the individuality of those who participated in the process.

True progress of Art is always co-existent with the prevalence of individualism. The efforts of the Pre-Raphaelite Brotherhood, which was a distinctly individualistic movement, resulted in an impetus to Art which cannot be sufficiently estimated. We in our time see much of the fruit of these efforts, but their full significance is hardly yet apparent. The fruits of it are yet to ripen in the years to come. All great reformations are brought about by the spontaneous action of originality and individuality, which will assert itself in spite of the greatest difficulties which may assail it.

The evolution of Art offers an analogy to the nebular hypothesis. We have the great nebulous mass, homogeneous throughout: by its movements a ring is thrown off which condenses into a planet, an individual, with a separate existence of its own. This is the production of the individual from the mass. The process is continued until the nebula has produced many such planets, each of them having a distinct individuality. The homogeneous has split up into the heterogeneous: for the planets to resolve themselves again and become part of the original mass would be a backward step. For individuals to become Socialists is reversing progress. It is a change from the heterogeneous to the homogeneous, which cannot but be followed by disaster. In Social Science this is true; in Art it is true also. Institutions of all kinds should be watched with the utmost care, for their inevitable tendency is to crush individualism. This has become painfully apparent in the Royal Academy. Many of our greatest modern painters have held entirely aloof from it, and those other great men who are now R.A.'s or A.R.A.'s are only so because the outcry against the institution has become so menacing. The Royal Academy most foolishly, though as is generally the case unconsciously, instituted a standard of merit to which all artists must attain before they could be admitted into its body. This standard has varied according to the ideas of the men forming the Academy. That such a system was pernicious goes without saying, for artists who were struggling for a livelihood would necessarily endeavour to attain to this Academy excellence, for it meant money. It is only in a few rare but glorious cases that the individuality has been so pronounced that it has enabled its possessor to struggle on through despair, neglect, and poverty, and make for himself that position in the world which it is beyond the power of all Academies to give—the position of one of the world's heroes.

Art schools and the progress of universal Art training, too, should be watched very narrowly. That these influences will result in the production of mediocrity and uniformity in Art work is certain. That their system will nourish and develop genius is not so certain. Individuality will assert itself, and if it gets into the curriculum of a provincial Art school and finds that it is not sufficient, then individuality will have its way, either in the alteration of the system pursued at the school, or by leaving it. Therefore, where extraordinary talent manifests itself, it should be the first duty of the officers of the institution to foster it in its own peculiar way; not to adhere strictly and uniformly to the rules and regulations of the school. In many instances it is absolutely impossible for a man with genius to go through all the petty annoyances, tests, and examinations that are so very necessary to the ordinary student.

It is curious to note that although religious institutions have in many cases had so pernicious an influence on progress, yet in the cases of painting, architecture, and sculpture, and in music too, their influence has been good and useful.

Some of the world's greatest paintings have been done expressly for the purposes of religion; some of the noblest specimens of architecture are found in temples, cathedrals, and churches. Some of our most beautiful music is that composed expressly for church services, as the Masses of Mozart, Schubert, Gounod, and others. I do not say that the religious influence has been entirely good, because, as I have already pointed out, ornament and decoration are not the highest forms of Art, and work done for the great religious establishments was almost wholly decorative or ornamental. There is a seeming paradox in this consideration, for while religion has called forth some of the sublimest efforts of the greatest geniuses, religious bigotry and oppression has, sadly enough, destroyed many noble and glorious works in Art, Literature, and Science. That Art has in some cases been degraded by its contact with doctrinal religion is also a fact which needs no proof. That such a mind as that of Shelley, so wholly attuned as it was to the delicate influences of Art, should be disgusted by some of Michael Angelo's work, is not surprising when we consider what that work was. Some of his most celebrated pictures are representations of a repulsive, savage, awful being, which is meant to represent God. Men with the same ideas concerning the unknowable as those of Shelley cannot help being affected in the same way by these fearful productions. They are repulsive alike to the eye and to the mind. Architecture owes a vast deal to religious institutions; so much so, that we cannot sufficiently estimate it—all the splendid cathedrals and churches which adorn our own land, and those which are among the great glories of the Continent; all the magnificent temples of India and China, and all those of ancient Greece and Rome, the ruins of which still are marvellously beautiful, delighting the eye of him who can see beauty, and forming the inspiration for many a noble poem. But sadly enough, as in painting, so in architecture, we are troubled by the edifices erected by the Primitive Methodist, which he calls the "Temple of God," and with which he disfigures an otherwise picturesque little village in a way most distressing. Although the Masses composed for church services are of extreme beauty, we still have to contend with the comic music set to the still more comic words of the Salvation Army man. We see from this that religion, as applied to the Arts, has not been altogether beneficial. It is, in some of its forms, answerable for much that is derogatory and debasing in Art, while, on the other hand, it has been in many directions the friend and nourisher of the artist and of his work.

In reference to Criticism, which I regard as one of the Arts, it is individualism which plays the most glorious part—the man of originality who can break away from the established canons of bygone times, and assert himself by the views he holds. It was Emerson—a great prophet of individualism—who, when all other critics went astray, saw the grandeur of "Sartor Resartus," the great prose poem of the mighty individualist Carlyle. The man who is affected most by Nature is he who is most affected by Art, and as Emerson expresses it:—"The individual in whom simple tastes and susceptibility to all the great human influences overpower the accidents of a local and special culture, is the best critic of Art." * There are critics who scarcely answer to this description, but then, they are neither "susceptible to the great human influences" or to any influences whatsoever.

It would be pleasant to linger over some of the great names which have been such prominent examples of individualism in the present century—a century which is remarkable for the progress of individualism among a certain class of the community, and which has seen the rise of those ideas which in England are termed Democratic. (Of the Socialist movement, about which we hear so much just at present, it is hardly necessary to speak, for it is but a passing phase of the discontented, who, like the poor, are ever with us. That Socialism will not cure their maladies it requires but a year or two to prove.) The poet-painters alone furnish us with splendid examples of individualism. The wonderful genius of Blake, with his strange visions, his lurid paintings and weird poems, made an assertion for individuality which could not be withstood. Those by whom he was surrounded did their best to mould him into the orthodox shape, but they were peculiarly unsuccessful. He continued in his own way, inventing his own methods, producing his compound works of Art in painting and poetry. Dante Gabriel Rossetti, another great individualist who worked in the same arts as did Blake, if not so strange in his methods and life, was as great a genius. Some of his works in poetry, while they do not display the strangeness of some of Blake's, have qualities which Blake's poetical work does not possess. Their grace, their beautiful examples of alliteration, their perfect form, their effect upon the senses, are allurements which cannot be withstood when once the spirit of their author is thoroughly assimilated. In painting, his work is the greatest ever done by an Englishman. As a colourist he is the rival of the greatest

* Emerson. Essay on "Art."

names of Continental artists. His pictures have the same psychological effect as his poems, producing a species of subdued delight which is only effected in this high degree by his works, but which is occasionally approached when some of the pictures of Mr. Holman Hunt, Mr. Burne Jones, or Mr. Watts, or some of the poems of Shelley, Keats, or Coleridge, are the subjects of contemplation. There are other great poet-painters, too, who have influenced the thought of the century very strongly—Sir Noel Paton, Mr. W. Bell Scott, and others. In the region of prose literature many great names immediately suggest themselves—Goethe, Carlyle, George Eliot, and Mr. Ruskin; in science—Dr. Huxley, Prof. Tyndall, and Sir Richard Owen; in philosophy—John Stuart Mill, Darwin, and Mr. Spencer; in music—Wagner and Gounod: all these have impressed their individuality upon their time with a stamp that can never be obliterated. These are the great individualists who have made their respective arts so glorious and so famous. What has been done in the past for Art by individualism will, as civilization and its accompanying culture progresses, develop into something even greater and grander. It is only to individualism that we can look with certainty for progress and development: if collectivism steps in and usurps its place, then the progress of Art, as well as everything else, must necessarily end.

We have, then, briefly traced the origin and development of the Arts. We have found that progression consists in the development of the homogeneous into the heterogeneous alike in Art and in life. We have seen that the highest Art is co-existent with the greatest display of individualism, and that all great efforts exerted in order to alter some current mode of thought and opinion were the efforts of the individualism which displays itself wherever genius is present. We have also seen that where collectivism is the prevailing feeling true high Art cannot exist, be produced, or be enjoyed. As Art-work is *produced* by the individual, so does it *administer* to the individual. It affords him scope for thought and feeling, it affords him delight and pleasure.

In this our day, when to be great all Art must possess the scientific spirit, we must look to it that Science shall possess the *artistic* spirit too; that it shall not run into materialism or any other of the thousand pitfalls which beset its path of progress. There must be a glorious union of Science and Art. "When Science is learned in love, and its powers are wielded by love," and the whole of Science is artistic, and the whole of Art scientific, then the prophet of the movement will arise, and lead his army of workers, and the triumph of the teachings of the Synthetic Philosophy will be complete.

HISTORY OF THE COUNTY BOTANY OF WORCESTER.

BY WM. MATHEWS, M.A.

(Continued from page 261.)

A List of Malvern Plants, appended to a paper by Mr. Wm. Ainsworth, M.R.C.S., entitled "A Sketch of the Physical Geography of the Malvern Hills," in Jameson's "Edinburgh Philosophical Journal" for 1828, pp. 99—100, has been kindly extracted for me by Mr. Druce, of Oxford. It should, as well as the List next in order, have preceded that of Perry.

It contains, among others, the following records :—

Cistus Helianthemum. (*H. vulgare.*)

† **C. polifolius.** (*H. polifolium.*) *Must be an error.*

Ulex europæus.

* **U. nanus.** *This is U. Gallii. Planch.*

* **Genista anglica.** Scattered about the Hills.

Spartium scoparium. Little Malvern.

Ononis arvensis.

Campanula rotundifolia.

† **Polygonum viviparum.** *An error.*

* **Orchis ustulata.**

O. (*Habenaria*) **bifolia.** *Almost certainly H. chlorantha. Bab.*

The List, from which the above is an extract, contains 36 plants, of which 6 are new records.

The name of my friend, Mr. Edwin Lees, of Worcester, a name more intimately connected with the botany of his county than that of any other writer, must now be introduced into this history. His first botanical work was a catalogue of the "Plants on the Malvern Hills," made in the year 1829, and published in Loudon's "Magazine of Natural History," Vol. III., 1830, p. 160.* This record should have taken precedence of that of Perry, which was published in Vol. IV., 1831, of the same work, although Perry's observations were for the most part made earlier than those of Mr. Lees. Unfortunately I did not find Mr. Lees's article until Perry's List had gone to press. There is another paper by Mr. Lees in Vol. IV. of the same periodical, p. 437, in which a few Worcester plants are mentioned, but it will be unnecessary to refer to them in this place. Mr. Lees has

* Mr. Lees published a previous List in 1828, which will be referred to hereafter.

passed away from us since this paragraph was first in type, his botanical work having extended over a period of nearly sixty years.*

The Malvern List contains a few records from the County of Hereford which is entangled with that of Worcester in the vicinity of the Malvern Hills. These I have marked with the letter H. There are also a few cases in which I think the author has fallen into error in the identification of his plants.

Edwin Lees: in Loudon's "Magazine of Natural History," Vol. III., 1830, p. 160. "Plants on the Malvern Hills." The List is dated September 18th, 1829.

* **Ranunculus parviflorus.**

* **Aquilegia vulgaris.**

* **Fumaria** *(Corydalis)* **claviculata.**

* **Cistus Helianthemum.** *(H. vulgare.)*

* **Drosera rotundifolia.** Bog on western side of the Beacon.

* **Dianthus Armeria.**

* **Stellaria uliginosa.**

* **Spergula saginoides.** *(S. nodosa, L., must be the plant intended.)* In a marshy spot on the western side of the Worcestershire Beacon. Also in another springy spot near the Wych.

Arenaria rubra. Abundant on the rocks. Also near the Wych.

* **Montia fontana.** In plashy rills on the Hill.

* **Hypericum Androsæmum.** In a wood near Little Malvern Priory.

H. pulchrum. Abundant on the heathy ground at the north base of the End Hill.

Tilia parvifolia. Woods at the north end of the Range.

* **Linum usitatissimum.** Near Little Malvern.

* **Geranium lucidum.**

Ilex Aquifolium. Almost covering the hills in the southern part of the chain.

* **Anthyllis Vulneraria.**

† **Trifolium ochroleucum.** On the Link Common. *Must, I think, be an error.*

* **Ornithopus perpusillus.**

Hedysarum Onobrychis *(O. sativa).* On the limestone rocks.

* **Vicia sylvatica.** In the wood below the Worcestershire Beacon.

Spiræa salicifolia. Near Welland Common, perhaps naturalised there, as a garden was not far from the spot.

Alchemilla vulgaris.

* **Potentilla argentea.** Plentiful on the rocks.

H **P. verna.** On the rock above the cave on the Herefordshire Beacon.

Rosa villosa. *(R. mollissima.)*

* Mr. Lees died on the 21st October, 1887, at the advanced age of 87.

R. tomentosa.

* **R. rubiginosa.**

R. micrantha. On the thickety side of the Warren Hill.

R. Borreri. In the woods.

R. Forsteri. In the woods. *Var. of R. canina, now known as R. urbica, Leman.*

Pyrus torminalis. In the woods.

P. Aucuparia. Numerous at the base of the North Hill.

Circæa lutetiana.

* **Sedum Telephium.** Abundant on the rocks of the North Hill.

S. acre. Abundant on the rocks of the North Hill.

* **S. album.** Abundant on the rocks of the North Hill.

* **Cotyledon Umbilicus.** Numerous in the fissures of the rocks.

* **Chrysosplenium oppositifolium.** Abundant in shallow plashy rills.

* **Sium repens.** In marshy ground on the west side of the Worcestershire Beacon.

H * **Viburnum Lantana.** In the woods on limestone near Ledbury.

* **Asperula odorata.**

* **Dipsacus pilosus.**

* **Carlina vulgaris.**

* **Anthemis nobilis.** Abundant on the wet commons near the Hills.

Solidago Virgaurea. On the rocks.

† **Hieracium murorum.** On the rocks.

I suspect H. vulgatum, Fries, abundant on the rocks at Malvern, is the plant intended here.

* **Vaccinium Myrtillus.** On the rocks of the Worcestershire Beacon.

Calluna vulgaris. No other kind of heath grows throughout the range.

H * **Vinca minor.** In a wood on the summit of a limestone hill near Cradley.

* **Chlora perfoliata.** Near the limestone quarries.

* **Gentiana Amarella.** On limestone in a rocky wood near the Wych. Plentifully.

Cuscuta Epithymum. On the North Hill.

Datura Stramonium. On waste ground near the Church.

* **Hyoscyamus niger.** In abundance at the base of the Hills near the Wells.

* **Verbascum Thapsus.** In abundance.

* **V. Blattaria.** Side of the road to Worcester.

* **Digitalis purpurea.** In all parts of the range. Profusely.

† **Veronica triphyllos.** At the northern extremity of the Link Common. *An error. See "New Botanists' Guide," p. 622.*

Lathræa squamaria. At the base of the North Hill on the roots of holly, and in a thick wood on a conglomerate near the Teme on the roots of maple.

Lycopus europæus.

Mentha piperita. Plentiful by the rills on the Chase.

M. viridis. By the side of a stream near Newland.

* **Thymus Calamintha.** *(C. menthifolia.)* Abundant.

* **Nepeta Cataria.**

Lithospermum officinale.

Myosotis cæspitosa.

* **Cynoglossum sylvaticum.** In the woody glen at the foot of the Warren Hill, Little Malvern.

* **Pinguicula vulgaris.** In a bog on the west side of the Worcestershire Beacon, but in no other part of the Hills.

* **Anagallis tenella.** Mossy bog at the foot of the Worcestershire Beacon.

Rumex palustris. Marsh by the Chalybeate Spring.

* **Polygonum Bistorta.** In moist copsy meadows to the north of the Hills.

† **P. viviparum.** *No locality stated. An error. See "New Botanists' Guide," p. 203.*

* **Juniperus communis.** On the limestone rocks.

* **Taxus baccata.** Abundant in the woods on limestone.

* **Triglochin palustre.** In boggy places.

* **Orchis pyramidalis.** On the limestone banks.

* **O.** *(Gymnadenia)* **conopsea.** Covering whole meadows at the foot of the northern limestone eminences.

* **O.** *(Habenaria)* **viridis.** In pastures at the base of the North Hill.

* **O.** *(Habenaria)* **bifolia.** In the woods.

Almost certainly H. chlorantha. Bab.

* **O.** *(ophrys)* **apifera.** On the limestone rocks at Leigh Sinton.

* **Neottia spiralis** *(Spiranthes autumnalis).* On the wet commons.

* **Narcissus Pseudo-narcissus.** In profusion in a wood near Little Malvern Church.

H * **Galanthus nivalis.** In great abundance in a mossy glen at the north-western base of the Herefordshire Beacon, and in the adjoining wood.

* **Paris quadrifolia.** In the thick woods at the western bases of the two beacons.

Tulipa sylvestris. This was found among the limestone quarries by Jas. T. Goodman.

* **Colchicum autumnale.** Abundant in the moist meadows on the western side of the Hills.

Eriophorum polystachion. In a bog on the western side of the Hills.

Aira caryophyllea.

Festuca gigantea *(Bromus giganteus).* On the limestone hills north of Malvern.

† * **F. Calamaria.** On the limestone hills north of Malvern. *I suspect an error in this locality.*

* **Nardus stricta.** On the commons.

A further list of "plants varying in the colour of their flowers" follows the list of "plants on the Malvern Hills." The following Worcester records are extracted from it:—

Polygala vulgaris. White flowers. (*Possibly the typical form.*) On limestone to the north of Malvern.

Geranium pusillum. White flowers. Henwick Hill, on sandy ground.

* **Saponaria officinalis.** With double flowers. In a hedge on the road to Cothridge.

Spiræa Ulmaria. With full flowers. In a marshy place at Battenhall on the road to Cruckbarrow Hill.

Rubus leucostachys. In a hedge on the north side of Worcester.

R. glandulosus. Bromsgrove Lickey.

Carduus nutans.

* **Antirrhinum majus.** Cream coloured flowers. On an old wall near the Commandery, Worcester.

Betonica officinalis. White flowers. Helbury Hill, west of Worcester.

Prunella vulgaris. White flowers. West side of Worcester.

Crocus vernus. With white flowers. In a low field south side of Worcester.

There are so many old records in these lists that it will be convenient to recapitulate the new ones.

Arenaria rubra.
Hypericum pulchrum.
Tilia parvifolia.
Geranium pusillum.
Ilex aquifolium.
Hedysarum Onobrychis.
(*Onobrychissativa.*) (*Perry.*)
Spiræa salicifolia.
S. Ulmaria.
Alchemilla vulgaris.
Rubus leucostachys.
R. glandulosus.
Rosa villosa.
R. tomentosa.
R. micrantha.
R. Borreri.
R. Forsteri. *Var. of canina.*
Pyrus torminalis.
P. Aucuparia.
Circæa lutetiana.
Sedum acre.
Solidago Virg-aurea. (*Perry.*)
Calluna vulgaris.
Cuscuta Epithymum.
Datura Stramonium.
Lathræa squamaria.
Lycopus europæus.
Mentha piperita.
M. viridis.
Betonica officinalis.
Prunella vulgaris.
Lithospermum officinale.
Myosotis cæspitosa. (*Perry.*).
Rumex palustris.
Crocus vernus.
Tulipa sylvestris.
Eriophorum polystachion.
(*Perry.*)
Aira caryophyllea.
Festuca gigantea.
(*Bromus giganteus.*)

It thus appears that Mr. Lees contributes in his first list of Worcester plants 38 new records, 4 of which must be taken away from Perry, thus reducing his number from 32 to 28.

(To be continued.)

THE MIDDLE LIAS OF NORTHAMPTONSHIRE.

BY BEEBY THOMPSON, F.G.S., F.C.S.

(Continued from page 255.)

What is the Storage Capacity of the Material of the Bed?—I am not aware of any experiments bearing upon the question of the actual capacity of the Marlstone for water. According to Professor Ansted* many building stones will absorb about a gallon and a half of water per cubic foot, ordinary Sandstones about one gallon, best building stones of the Sandstone group four to five pints, and Limestones generally more than a gallon. Considering that the Marlstone Rock-bed is a calcareous Sandstone, I thought that an average capacity of one gallon per cubic foot would be a fair estimate. To test this, four specimens of the rock were selected; they were dried first in a water-bath, and afterwards on a sand-bath at a temperature of about 200° C., and immersed in water for several hours before taking the specific gravity, then left suspended in a loop of platinum wire to drain before the final weighing. The additional loss by drying at the higher temperature varied from ·23 to ·6 per cent. of the total weight of the specimen. The stone distinctly lost weight from evaporation of water whilst the weighing was being conducted, and therefore, of course, during the time it was draining.

No. 1. Was a hard Oolitic stone of a greenish colour, containing fossils.

No. 2. A ferruginous stone of a ruddy colour, with fossils, and some crystallised carbonate of lime.

No. 3. A hard green stone closely resembling No. 1.

No. 4. A hard grey stone, one surface of which had become oxidised.

* "Applications of Geology to the Arts and Manufactures," by Prof. D. T. Ansted, M.A., F.R.S.

The results obtained are tabulated below :—

TABLE SHOWING DATA FROM WHICH THE CAPACITY OF MARLSTONE ROCK FOR WATER WAS DEDUCED.

No.	Specific gravity.	Weight of Dry Stone in grammes.	Weight of Stone saturated with water in grammes.	Weight of Water in grammes.	Bulk of Water compared to bulk of Stone.	Gallons of Water per cubic foot of Stone.
1	2·945	7·870	8·290	·420	·157	·98
2	2·7	15·16	16·34	1·18	·21	1·3
3	3·0	46·467	48·910	2·443	·16	1·0
4	2·78	56·285	59·236	2·951	·146	·91

It will appear from this table that the average capacity of these particular specimens of rock for water is a little over one gallon per cubic foot, and the balance of possible errors was certainly in a direction tending to reduce the calculated capacity. Making an allowance of one-third of a gallon for water which would always be retained by the rock under the particular conditions in which it is met with in the ground, there would still be room for two-thirds of a gallon per cubic foot, of what we might call replaceable water.

One cubic foot = 6·25 gallons, therefore, if one cubic foot of rock in its normal condition is capable of receiving two-thirds or $\cdot\dot{6}$ gallons of water, it is equal to $\cdot\dot{6} \div 6{\cdot}25 = {\cdot}107$ gallons, or a little over one-tenth of its bulk. Thus, neglecting the capacity of the fissures, one square mile of rock, 6ft. in thickness, could receive or yield over 111,000,000 gallons of water.

WHAT IS THE AREA TO BE FILLED?—In considering the storage capacity of the bed itself, naturally, a volume of water equal to nine-tenths of the volume of the fissures ought to be added to the estimate given above, for in these fissures there is, or might be, a full cubic foot of water where only one-tenth has been allowed for. I cannot give the least idea what that volume should be, but I may say, without any hesitation, that the storage power of the bed as a whole is considerably greater than that given for the material of the bed.

On the other hand, six feet, about the average thickness of the Rock-bed for the county, is not the average for the particular district which alone can assist Northampton, indeed so much is the Rock-bed reduced in the northern parts of the county that I should think an average of three feet would be sufficient. It is, perhaps, important to mention that the area that would first be affected by filling up the Marlstone would be that nearest Northampton, where the average thickness may be more than six feet.

As one of the boundaries of the area to be filled is the Nen "fault," it would be better here perhaps to say what is known of this "fault."

THE NEN "FAULT" is first mentioned in the "Memoirs of the Geological Survey,"* and is marked on the map by a white line. According to the Memoir and map the "fault" extends from Newnham to Kislingbury, *i.e.* about eight miles, and is greatest at Weedon, where on the south side of the valley the Upper Lias is brought into contact with the Lower Lias, entirely cutting out the Middle Lias. I cannot add much to the information given above with respect to this neighbourhood, but during the recent works in connection with the new railway line from Weedon to Daventry, the Middle Lias was well exposed near to the station and barracks, and from the thickness of it there we can estimate the minimum displacement necessary to bring the Upper Lias into contact with the Lower Lias; this would be about 30ft. It is, of course, very probable that the actual displacement, particularly where increased by the subsidiary N.W. and S.E. "fault," is much more, for the actual zone of the Lower Lias against which the Upper Lias abuts is not known, and the lowest beds of the Upper Lias are not shown, although they are presumably present, as they are well developed on the northern side of the same valley.

At Kislingbury the displacement seems to be much less than at Weedon, for a little east of Kislingbury a connecting link of Middle Lias is shown across the valley, though the Rock-bed is absent.

At Northampton we have evidence of a "fault" in which the displacement is greater even than that at Weedon, for on the northern side of the Nen valley the Middle Lias Rock-bed is only 75ft. above sea-level, whereas on the southern side the lower water-bearing bed is about 130ft. above sea-level. Allowing 20ft. (the recorded thickness at the Spinney

* Description of Quarter Sheet No. 53, S.E., by William Talbot Aveling, F.G.S., and Richard Trench, B.A., F.G.S. Published in 1860.

Well was 21ft.) for the thickness of the Middle Lias in this neighbourhood, it will be evident that the total displacement is about 75ft.

Two wells have been made on the south side of this "fault," and it is these that have supplied the necessary evidence with regard to it. One at Messrs. P. Phipps and Co's. Brewery passed through 27ft. of alluvium and gravel, and about 30ft. of alternating beds of clay and rock before reaching the water-bearing bed. Another, at the London and North Western Railway Station in Bridge Street, seems, according to the account left of a boring made there, to have passed through the Middle Lias at 46ft. The description runs as follows:—

Superficial accumulation, consisting of detrital gravels, dark tenaceous clays, with erratic boulders	46ft.
Lias blue clay, with bands of stone	550ft.

A well at Delapre Abbey, 40ft. deep, is also supposed to reach the Marlstone, but whether the upper or lower spring is tapped is uncertain. The Abbey is only a little over a third of a mile S.E. of the railway station.

It will be seen on reference to a map, that the three places particularly mentioned, viz., Weedon, Kislingbury, and Northampton are situated almost in a straight line running east and west, and that this coincides almost exactly with the direction and position of the Nen as far as Northampton.

The "fault" is only marked on the Geological maps as extending from Newnham to a little east of Kislingbury, but it appears quite evident (*a*) that the fault at Northampton is a continuation of the other, and, if so, (*b*) that in this part of the Nen valley the "fault" and the river stand related to each in the manner of cause and effect.

With respect to the first contention (*a*), it is probably unnecessary to say much, because a displacement of 75ft. must have had an effect much beyond the immediate neighbourhood where it has been detected, and being, so far as can be ascertained, in almost an exact line with the older known "fault," and within three miles of it as marked on the Geological maps, it is extremely unlikely that it should be a separate one. The evidence to be obtained from wells, too, shows that the northern and southern Marlstone areas are quite disconnected. It may be that the neighbourhood of Kislingbury formed, as it were, the fulcrum about which the movement took place that resulted in the southern area becoming highest at Northampton and lowest at Weedon.

With regard to the second statement (*b*), I would say that the presence of a "fault" coincident for nearly 11 miles with the Nen valley cannot be regarded as the result of chance, Moreover, the arrangement is quite in accordance with statements previously made with respect to the origin of "faults" and valleys (see page 231, Vol. X.).

We are now in a position to define, with a considerable degree of probability, two of the boundaries of the area that might be filled with water, for two lines may be drawn on a map from the position of Northampton, one running westward along the Nen valley, representing the boundary of the southern area, which can neither give water to nor take water from the northern area; and the other at an angle of 125° with this, *i.e.*, in the direction of strike of the bed, on one side of which the Marlstone is full and the other requires filling. I candidly admit my inability, at present, to even approximately define the other boundary, as it depends upon the inclination of the bed, and the artesian gradient, neither of which are known with a sufficient degree of certainty. Of course, dumb wells constructed anywhere between the lines just referred to, and within the outer boundary of the Marlstone outcrop, could help to fill up the bed. Hence a previous suggestion of a radius of 15 miles for such wells, but it does not follow that the bed could ever be filled up to their position.

What is known about the inclination of the Marlstone I will now give, more for future reference than present use.

The Marlstone at Northampton is 75ft. above sea-level, at Daventry 490ft., a fall of 415ft. in $11\frac{3}{4}$ miles = $35\frac{1}{3}$ft. per mile, nearly.

At Naseby, about 11 miles from Daventry on the line of strike, the Marlstone is said to be 500ft. above sea-level, a fall of 425ft, in 12 miles = $35\frac{1}{2}$ft. per mile, nearly.

The true dip deduced by taking a line at right angles to that joining Daventry and Naseby and passing through Northampton, gives 40ft. per mile.

These are satisfactory and consistent enough if taken by themselves, but do not agree with the inclination deduced in another direction in another way. It has been remarked and explained in Part I. that where streams run over clay beds, the beds have the same dip or inclination as the valleys in which they are exposed, it thus seemed probable that we might ascertain the dip of the Middle Lias by the fall of the river.

The average fall of the Nen between Northampton and Wansford is 38·7 inches per mile. The actual fall of the Nen from Northampton to Wellingborough is about 45ft., and the straight distance almost exactly 10 miles, so that probably the river in winding about increases the distance by 4 miles ($14 \times 38{\cdot}7$in. = $541{\cdot}2$in. = $45{\cdot}1$ft.). Now I happen to know that the same zone of the Upper Lias is met with nearly on a level with the river at Northampton, Wellingborough, and Higham Ferrers, and, therefore, we should expect to find the Middle Lias at somewhat the same depth from the surface at these places. After making due allowance for these places being a less distance from the line of strike than they are actually from Northampton, that is making them 6 miles and 8 miles respectively from that line, we only get 7½ft. dip per mile, as compared with 40ft. arrived at in another way.

(To be continued.)

Review.

Report of the Rugby School Natural History Society for 1886. 8vo., 69pp., illustrated. A. J. Lawrence, Market Place, Rugby.

This twentieth annual report of the excellent Natural History Society established in connection with the famous school at Rugby certainly does not yield in interest to any of its predecessors.

The report of the work done during the year includes a description of the development of a vivarium, in which quite a large collection of birds and small animals are maintained. The Archæological Section has been revived, and the museum has been enriched by the geological collection and library of the late J. K. Worthington.

The "local lists" have frequently been a valuable feature in the report, and we find here a list of birds noticed near Rugby, by J. E. Kelsall; while Mr. Wait gives a list of many plants which have been found in the neighbourhood since the publication of the local flora in the report for 1875.

Among the papers printed we note a very interesting and well-illustrated account of the "Dispersion of Seeds and Spores," by the Rev. H. Friend, F.L.S.; Mr. Seabroke (who still continues to work in the admirable "Temple" Observatory attached to the school) shows how the "Motion of Stars in the Line of Sight" is measured with the spectroscope; and there are also descriptions of a "Visit to Wicken Fen," the "Natural History of Northumberland," &c. The reports of the sections show that good work has been done in Archæology, Meteorology, Botany, Zoology, and Entomology.—W. J. H.

Check List of British Mosses, from Dr. Braithwaite's "British Moss Flora," Vol. I., price 3d., postage extra. This is a list of all the species and varieties enumerated and described in Vol. I. of the "British Moss Flora," and being printed on one side of the paper only will serve either as a check list, a note book, or as labels for the herbarium. It may be had, with or without paper covers, of the author, 303, Clapham Road, S.W.

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—The Session of this Society was inaugurated on Tuesday, October 4th, by a most successful Conversazione, held in the Examination Hall of the Mason College. The attendance numbered nearly 200, including no less than eight past-presidents of the Society, viz., Messrs. W. R. Hughes, F.L.S. (1864-6 and 1873), W. P. Marshall, M.I.C.E. (1869), G. Deane, D.Sc., F.G.S. (1874), Lawson Tait, F.R.C.S. (1876), Edmund Tonks, B.C.L. (1877-8), J. Levick, F.R.M.S. (1882), T. H. Waller, B.A., B.Sc. (1883-4), and R. W. Chase (1885-6). Amongst those present were Professors Tilden, F.R.S. (President of the Birmingham Philosophical Society), Allen, Lapworth, and Hillhouse; Dr. Anthony, Mr. Horace Pearce, F.G.S. (President of the Dudley Geological Society), Mr. J. B. Stone (Mayor of Sutton Coldfield), Mr. E. de Hamel (Tamworth), Mr. Councillor Barclay, and many others. There was a very fine collection of exhibits:—A large number of zoological specimens, from the Museum of the Mason College, shown by Professor Bridge; a very beautiful exhibit of British Birds, mainly albinos and downy birds, from the private collection of Mr. R. W. Chase; an extensive series of negatives of photographs of Alpine scenery, by Mr. C. Pumphrey, and of flowers, &c., by Mr. C. J. Watson, who also exhibited a number of "nature-printed" British ferns; a collection of minerals and fossils from the College Museum, by Professor Lapworth, including rare and valuable specimens; a complete collection of the sedges of Warwickshire, by Mr. J. E. Bagnall, A.L.S.; a gigantic puff-ball (*Lycoperdon giganteum*), and a considerable number of vegetable monstrosities, by Professor Hillhouse; many fungi, including numerous edible species, by Mr. W. B. Grove, B.A.; the spectrum of chlorophyll and blood, by Mr. E. F. J. Love, M.A.; living mosses, &c., by Mr. S. Walliker; Miss Taunton, photographs and specimens, mainly from Sicily; and a long list of microscopic specimens, by various exhibitors, including specimens illustrating the Hessian fly, by Mr. W. P. Marshall. The rooms were tastefully decorated with plants, lent by Mr. W. Spinks (of Messrs. Hans Niemand and Co.). In the course of the evening, the President (Professor Hillhouse, M.A., F.L.S.), gave a brief address, congratulating the members and associates on such an auspicious commencement of what he hoped would be a most successful Session, and commenting on the presence of so many former presidents of the Society. He had hoped that an address on the relations between Natural History Societies and the scientific work of Colleges and Universities (in that building so appropriate a subject) would have been delivered by Professor Bayley-Balfour, F.R.S., of Oxford, but, unhappily, pressure of work had caused an illness, which rendered it impossible for him to undertake the task at present. From a letter which Professor Balfour had sent him, Professor Hillhouse read a long extract, drawing attention to the strong necessity which exists in the present stage of biological teaching in England for systematic attempts to cultivate a love of nature in the earlier portion of the student's life, so as "to make that blend between field naturalists and laboratory workers which is so important at the present critical juncture." BIOLOGICAL SECTION.—October 11th, Mr. R. W. Chase in the chair. A paper was read by Mr. W. P. Marshall, on "The Dredging

Excursion to Puffin Island at the recent Manchester Meeting of the British Association." This excursion was taken by a party of about fifty members, on the 3rd of September, by a special steamer from Liverpool to Puffin Island, at the entrance of the Menai Straits, forty-five miles distance. The party was under the leadership of Professor Herdman, of Liverpool University College, and was well supplied with several dredges and tow-nets, and a trawl-net. Numerous interesting specimens were taken, including some rare in the district. The new station was visited that has been established this year on Puffin Island by the Liverpool Marine Biological Committee, containing a zoological laboratory, at which naturalists are afforded facilities for carrying out original research and investigations into the life history of marine animals, with the advantage of the continued supply of fresh specimens from a surrounding region containing a rich and varied marine fauna. An improved tow-net was described in the paper, that had been tried in the previous year's dredging excursion at Tenby, by the Birmingham Society, and some modifications were suggested from the further experience of its use.—GEOLOGICAL SECTION.—October 18th, 1887, Mr. Thos. H. Waller, B.A., B.Sc., in the chair, twenty-one members present. On the proposition of Professor Hillhouse, seconded by Mr. Clarke, and carried by acclamation, the warmest congratulations of the Section were presented to Mr. W. P. Marshall upon his election to the office of President of the Birmingham Philosophical Society. The following gentlemen were unanimously elected members:—Mr. Alfred Hughes, Paradise Street. Re-elected:—John Anthony, M.D., F.R.C.P., F.R.M.S., 6, Greenfield Crescent, Edgbaston; Mr. H. J. Sayer, Cambridge Street; Mr. Edmund Tonks, B.C.L. (ex-president Birmingham Natural History and Microscopical Society), Packwood, Knowle. Exhibits:—Mr. R. W. Chase, Richards' Pipit, *Anthus Richardi*, near Brighton; Mr. Charles Mantell, Jun., several photographs—"Ledbury Station Yard," showing passage beds, &c. Mr. T. H. Waller read a paper on "The Micro-Chemical Methods for the Examination of Minerals." The paper was illustrated by experiments in flame coloration, and solutions of minerals placed under the microscope.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—September 19th, Mr. Beale exhibited specimens of Roe stone and Pisolitic limestone from the Oolite, and a similar limestone, containing fossils of Saccamminia Carteri (a foraminifer), from the Bunter drift; also a specimen of the same rock from the Elf Hills, Northumberland; Mr. J. W. Neville, large variety of mussel from the Pacific; Mr. W. H. Bath, specimens of *Dorites apollo* and *D. delius* from Switzerland; Mr. Hawkes, a collection of fungi, including specimens of *Polyporus rufescens*, *P. betulinus*, *Coprinus comatus*, &c. Under the microscope, Mr. Hawkes showed a slide of five species of Mildew; Mr. J. W. Neville, section of *Favosites Forbesii*, a fossil coral.—September 26th, Mr. H. Hawkes showed a collection of fungi, including specimens of *Agaricus phalloides*, *A. butyraceus*, *Boletus badius*, *Paxillus involutus*, *Lactarius quietus*, and *Dœdalea quercina;* Mr. P. T. Deakin, specimens of *Sphærium ovale*. Mr. C. Beale then read a paper on "Anecdotes of Animals from Personal Observations." The writer observed that few pleasures were so great as those of noting the winning ways of our non-human friends. The anecdotes were numerous, and bore upon the sagacity of the horse, the intelligence and loving nature of the dog, the affection and love of home of the cat, and the many good qualities of other beasts and birds educated by, or brought into contact with, man. The paper concluded by recommending kindness to all dumb creatures, as they were a sacred trust, and should be cared for as such.—October 3rd, Mr. Corbet exhibited a collection of fossil coal plants in shale from Darlaston; Mr. J. W. Neville, chirping file and drum of cricket.—October 10th, Mr. H. Hawkes showed specimens of the following fungi:—*Agaricus elatus*, *Panus conchatus*, *Nectria cinnabarina*, and *Tubercularia vulgaris*, the two last being a common instance of dimorphism; Mr. J. Madison, a curious shell of *Limnæa stagnalis*, which had two distinct lips. Under the microscope, Mr. Collins showed *Vaucheria hamata;* Mr. Mulliss, moss fruits; Mr. Hawkes, a large series of slides of microscopic fungi.

CARADOC FIELD CLUB.—The concluding meeting of the season—specially devoted to the study of Cryptogamic botany—was held at Pulverbatch on Friday, September 23rd. The party drove first to Pontesbury, and then proceeded on foot through the woods to Westcott, and thence over Cothercot Hill to Castle Pulverbatch. Here a halt was made at the Mound, where stood the fortress which was probably founded by Roger Venator, one of the followers of the Conqueror. On the drive homewards, the party paid a visit to Lower Moat Farm, which still contains some ancient portions, and stands on the site of a manor house of the Stapletons, who claimed descent from Roger Venator, lord of Pulverbatch. They also stayed for awhile at Stapleton Village to examine its very interesting church, the peculiarity of which is that it is really made up of two churches, the one built over the other, and originally forming a second storey. In the evening the Annual Dinner of the Club was held at the "George" Hotel, Shrewsbury, the President, Rev. J. D. La Touche, occupying the chair. After dinner, the President delivered his Annual Address on the work of the Club, and the following papers were also read:—"The Hessian Fly," by Rev. W. Houghton, M.A., F.L.S.; "Chlorophyll," by Mr. T. P. Blunt, M.A.; and "Methods of reproduction in Fungi," by Mr. W. Phillips, F.L.S.

DUDLEY AND MIDLAND GEOLOGICAL SOCIETY.—This Society held their last Field Meeting for this season on Saturday afternoon, October 8th, at Moseley, for the purpose of examining the fine exposure of glacial gravel and sand in the cutting of the Midland Railway. Mr. A. J. Evans, who has devoted a vast amount of labour to breaking up these pebbles in search of the fossils they contain, and whose fine collection formed so interesting a feature in the Geological Department of the Birmingham Exhibition last year, kindly undertook the guidance of the party, and exhibited a number of specimens of *Orthis Budleighensis*, worm-burrows, &c. from the quartzite pebbles, *Pentamerus*, &c. from the Caradoc sandstone, and crinoid stems, &c. from the mountain limestone, and explained the character of the pebbles most likely to contain fossils. A few fossils were found, and the party were much interested in examining the lithological character of the stones, which is so varied, and unfamiliar to this district, *in situ*. Mr. Horace Pearce, F.G.S. (the President of the Society), expressed the thanks of the members to Mr. Evans for his kind assistance and valuable information.

THOMAS BOLTON, F.R.M.S.

It is with deep and unfeigned regret that we record the death of probably by far the most widely known of all our local naturalists, Thomas Bolton, who, after a short and, to most people, unknown illness, passed quietly away to his rest on Monday, November 7th, at the comparatively early age of fifty-seven. About a couple of months before, he had, for the good of his health which was suffering somewhat from an inactive liver, gone for a holiday to Bournemouth, from which place he returned with, however, but little relief. Shortly after his return, complications, arising probably in the main from a weakened heart, set in, and with comparative rapidity brought about the end.

Thomas Bolton had seen more troubles than most men. Born to good estate, he saw himself reduced to accepting, with thankfulness, the meagre pittance that the Birmingham Natural History and Microscopical Society could spare to him as its curator. And yet nothing appeared to disturb the natural happiness of his disposition, and probably few in the many hundreds or thousands of those who encountered him in the course of recent years dreamt that in him they saw a ruined ironmaster.*

Yet so it was. His father, likewise named Thomas, was partner in the firm of Messrs. Lee and Bolton, of Kinver, Staffordshire, at whose works at the Hyde were employed upwards of three hundred men. The chimney stacks of the works can still be seen down in the valley just beyond the point on the road from Stourbridge to Kinver where you pass Stourton Castle, the birthplace of Cardinal Pole; but, like many another former hive of industry, they lie idle and silent, and the busy hands who worked there have nearly all gone, God alone knows where. At Kinver, Thomas was born, the eldest son of his father and inheritor of his name, in the year 1831. He was educated in the first instance at Kinver Grammar School, and subsequently at King's College, London, then, more than now, a famous place for educating the children of the Staffordshire coal and iron masters, especially such as, like Bolton, were destined to become engineers.

* We are asked to mention, in the interest of the late Mr. Bolton's family, that he has by his will given all his scientific instruments, books, and apparatus to his son, Mr. Thomas Bolton, Junr., who was carefully trained as a microscopist by his father, and who will continue to carry on in Birmingham the business carried on for many years by his late father of supplying living objects for the microscope.—Eds. "M. N."

At King's College Bolton studied with marked success, especially in mathematics and natural philosophy. In 1848, he obtained a Junior Scholarship, and in 1849 was awarded an Associateship in Natural Philosophy. In 1851 he passed the Matriculation Examination of the University of London, being placed fifth in honours in mathematics and natural philosophy. But from this training ground he was suddenly withdrawn by the death of his father, in October, 1851 (likewise at the early age of fifty-five), compelling him to undertake the management of the works, and at about the same time another member of the Lee family, distantly related to Mr. Bolton, likewise entered the firm, namely, Mr. Yate Lee. From this time Mr. Bolton took a most active part in the whole educational and public life of Kinver, then a flourishing little town of some 4,000 inhabitants, and his efforts to promote the moral and intellectual well-being of the people were most untiring and unselfish. He was governor of the local grammar school, an honour which indeed he enjoyed up to the time of his death. He devoted weekly many hours of his evenings, which most other men would have spent in relaxation, to, on the one hand, prosecuting his own studies into microscopic life, and, on the other, to the endeavour to spread amongst the inhabitants of his own neighbourhood a desire for scientific knowledge, long before the value of such knowledge was so generally recognised by the public as it now is. It may be specially mentioned that he organised the first science classes ever held in his own district in connection with the Science and Art Department. When the Education Act first brought School Boards into existence, he shared in the labours of the first Board in putting the Act into operation at Kinver. He took an active part in the institution and management of evening classes, and in the work of the Young Men's Mutual Improvement Society. His devotion to the study of science brought him early in its formation into the ranks of the Birmingham Natural History and Microscopical Society, of which he became a member nearly five-and-twenty years ago, and likewise brought him into connection with the Dudley and Midland Geological Society, of which he was for several years one of the secretaries; and his scientific pursuits, thus cultivated, soon widely extended his acquaintance with men of similar tastes. Nor was it in these directions only that his interest in the popular good manifested itself. During his whole residence in Kinver, Mr. Bolton was an active man in church and parish matters generally, and filled the position of churchwarden for many years. While he held this office he devoted a good deal of time and attention to putting the charities of the neighbourhood upon a better footing, and was instrumental, with others, in securing the restoration of some of the bequests.

Side by side with all this outlying work, however, the state of their own business was a source of much anxiety. The formation of railways, so advantageous to the Midlands generally, was fatal to the trade of Kinver. Lying as they do right off the route of the iron roads, the Hyde ironworks were dependent upon water carriage alike for the coal and iron needed for their trade purposes, and also for the removal of the manufactured produce—bars, wire-rods, and the like. It can hardly be doubted, too, that Mr. Bolton had not a commercial soul, and it is not at all probable that his partner, with the training and instincts of a lawyer, was more fitted than he for the successful pilotage of a great commercial concern through the anxious years of the later sixties. In 1868 the crash came. For some years, it is true, Mr. Bolton continued at the works as manager for one of the chief creditors, who had purchased them, but at length even that despairing effort ceased, and the works were entirely closed. The whole of his private property gone, Bolton had to begin the world afresh at an age when many men are thinking of retiring, and with a young family dependant upon his exertions. He then removed to Birmingham.

It is from this event, however, that the widespread knowledge of Mr. Bolton's name and abilities is dated, for he spent his time and earned his living by searching out and providing materials for the investigations of other naturalists, turning to good account the experience gained during his quarter of a century of study at Kinver, sending living materials to all parts of the three kingdoms, while at the same time continuing his own investigations into the microscopic fauna of the Midlands. Thus, many of the specimens described in Saville Kent's "Manual of the Infusoria" were supplied by Mr. Bolton; and the same may be said of the rotifers in the classic work of Messrs. Hudson and Gosse; and several of these minute organisms have been named in honour of him. In our own columns this year (p. 124) are described four new species found by him and supplied to Mr. Gosse. In 1884 the Council of the Royal Society placed £50 at the disposal of Professor Ray Lankester for the purpose of employing Mr. Bolton to collect material for an investigation of the freshwater fauna of the Midland Counties; and at the Fisheries Exhibition a gold medal was awarded to him for an exhibit illustrating minute life relating to the food of fishes. In the same year (1884), on the death of Mr. W. H. Cox, assistant curator to the Birmingham Natural History and Microscopical Society, Mr. Bolton was appointed his successor, a step from which it cannot be doubted that the Society richly profited, as, in his daily attendance at the Society's rooms in the Mason College, he ever placed his knowledge freely at the disposal of all enquirers, and by which, therefore, his loss will be all the more keenly felt.

In bringing together the collection of exhibits in various departments of local natural history which formed such a remarkable feature of the Bingley Hall Exhibition, initiated for the purposes of the visit of the British Association to Birmingham in 1886, a permanent skilled superintendent was found to be necessary, and, without hesitation, the post was offered to Mr. Bolton, the Natural History and Microscopical Society gladly relinquishing its claims upon his time during the ten weeks that the exhibition was open. In this way Mr. Bolton's person became familiar to tens of thousands of visitors, while his own persistent attempts to interest the people in minute life by means of living microscopic exhibits added in no small degree to the interest and success of that unique exhibition. Advantage was taken, too, of the visit of the Association to bring to a successful issue an attempt, initiated by Mr. W. R. Hughes, F.L.S., the first president of the Birmingham Natural History Society, and Mr. T. Grosvenor Lee (son of Mr. Bolton's former partner, Mr. Yate Lee) to obtain from Government some recognition of Mr. Bolton's labours in the cause of science, and a memorial, signed by Sir W. J. Dawson, President of the Association, and by every biologist of repute who attended the meeting, secured from Lord Salisbury a pension of £50 a year upon the Civil List, dating as from June 30th of that year.* This

* It may be of interest to give a list of the signatures to this memorial, as a permanent record of the widespread estimation in which Mr. Bolton's labours were held:—

Sir J. W. Dawson, President British Association.
Thomas Martineau, Mayor of Birmingham.
Professor Michael Foster, Cambridge, Secretary Royal Society.
Professor H. N. Moseley, F.R.S., Oxford.
W. Carruthers, F.R.S., P.L.S., President Section D (Biology).
P. L. Sclater, F.R.S., Vice-President Section D.
Professor Milnes Marshall, F.R.S., Owens College, Manchester.
Professor G. B. Howes, Royal School of Mines.
Professor D'Arcy W. Thompson, University College, Dundee.
Professor W. Stirling, F.R.S., Owens College, Manchester.
Professor Marcus Hartog, D.Sc., Queen's College, Cork.
Professor Alfred H. Young, F.R.S., Owens College, Manchester.
Dr. Patrick Geddes, Lecturer on Zoology, Edinburgh.
W. Percy Sladen, Zoological Secretary, Linnean Society.

pension Mr. Bolton has unhappily not lived long to enjoy, but none the less is it a source of gratification to his innumerable personal and scientific friends that this highest honour that the English Government can pay to deserving merit was paid to him.

The funeral at Kinver, on November 11th, was the nearest approach to private that the circumstances of the case would admit, being attended, besides the immediate family and relations of the deceased, only by Mr. T. Grosvenor Lee, whose close historical relations with the family is sufficiently indicated above, and by the writer of this sketch, as representing Mr. Bolton's scientific friends, and especially the Society whose curator at the time of his death he was. Although the relics of the old works still living at Kinver are few, a small number of them, grey or white with years, spontaneously gathered together and acted as pall bearers to the remains of their former master and master's son. The day was emblematic of the fallen fortunes of Kinver; but the cold grey clinging mist, while it shut out the beauties of the scene as viewed from the grandly-placed churchyard, served but to concentrate thought and attention upon the hero of science, whose last years, spent amidst the gloom of financial difficulty, were yet brightened by a courage which naught could damp, and a Nature love which keepeth all things young.

W. Hillhouse.

Dr. J. R. Macfarlane, Lecturer on Botany, Edinburgh.
Henry B. Brady, F.R.S.
Professor F. O. Bower, M.A., Glasgow.
Professor Alfred C. Haddon, M.A., Royal College of Science, Dublin.
Professor W. Hillhouse, M.A., Mason College, Birmingham.
Professor T. W. Bridge, M.A., Mason College, Birmingham.
Henry Trimen, M.B., Peredenya, Ceylon.
Professor Alfred Newton, F.R.S., Cambridge.
Professor Alex. Macalister, F.R.S., Cambridge.
Professor Isaac Bayley Balfour, F.R.S., Oxford.
Professor E. Ray Lankester, F.R.S.. University College, London.
Professor Sir James Sawyer, M.D., Queen's College, Birmingham.
J. B. Stone, J.P., F.G.S., F.R.G.S., Mayor of Sutton Coldfield.
Sir John Lubbock, M.P., F.R.S.
Professor G. J. Allman, F.R.S., Edinburgh.
Dr. W. H. Dallinger, F.R.S., Pres. R.M.S.
Professor B. C. A. Windle, M.D., Queen's College, Birmingham.
Professor J. B. Haycraft, M.B., Mason College, Birmingham.
Professor W. A. Tilden, F.R.S., Mason College, Birmingham.
R. W. Chase, President Birmingham Natural History and Microscopical Society.
Thomas Grosvenor Lee, B.A., Birmingham.
W. R. Hughes, F.L.S., Borough Treasurer, Birmingham.

THE MIDDLE LIAS OF NORTHAMPTONSHIRE.

BY BEEBY THOMPSON, F.G.S., F.C.S.

(Continued from page 293.)

I might give numerous instances to show that the inclination of valleys, or the streams running through them, is not greatly different from the dip of the beds in the same direction, where the streams run over clay, though in some cases the dip of the beds may be a little the greater and in others the less. The stream rising near to West Haddon runs over the "unfossiliferous" beds of the Upper Lias near to Ravensthorpe and Holdenby respectively, but over the lower portion of the "Leda ovum" beds at Northampton, the distance being about seven miles. Again, one of the streams running by Kettering, and afterwards joining the Ise, runs over the "Leda ovum" beds at both Kettering and Wellingborough, although they are of a little lower zone at Wellingborough than at Kettering, distance about seven miles.

The fall of the Nen, from its source near Staverton to Northampton, would give an average incline differing only a little from that previously deduced for the Marlstone by taking the height of it at Daventry and Northampton respectively, for the river flows from the Marlstone, and rapidly cuts down to the Lower Lias clay,* and runs over that to within about three miles of Northampton, and then over its own alluvium, though originally it ran over Middle Lias again; that is, it formerly flowed over nearly the same beds at two places over thirteen miles apart.

Putting together the facts just enumerated, viz.:—(1) That streams running over clay beds, in Northamptonshire, do not materially cut into them, but run over their dip plains; (2) that the two branches of the Nen meeting at Northampton, actually run over higher beds there than they do over most of their course, and (3) that the dip of the beds, deduced from such information as is available, westward of Northampton differs considerably from that deduced from equally reliable data eastward of the town, it appears evident that the dip of the beds is considerably reduced as we approach Northampton from the west, on both sides of the Nen "fault," though more on the south side than the north. I would suggest that the position where this change begins is approximately indicated by the commencement of the river alluvium, that is

* This may at first be bed "M" of Middle Lias. (See Typical Section.)

to say, near Kingsthorpe on the north and Kislingbury on the west. By joining these two places where the alluvium is marked as commencing, we get a line deviating not very much from the strike of the beds, such deviation as there is being well explained by the preceding remarks. This theory is rendered the more probable by the fact that in one of the directions the alluvium commences only a trifling distance eastward of the point where Middle Lias reappears, as shown on the geological maps. This is also the position previously pointed out for the change in character of the Nen "fault," hence it affords additional evidence of the continuity of the older-known "fault" with the one more recently discovered. I may say here that no evidence of this "fault" has been discovered eastward of Northampton, and as the Nen makes a decided curve to the north-east soon after passing the town, it is unlikely that the two coincide further.

My readers will now naturally expect that I shall claim a less average dip for the Marlstone near Northampton than 40ft. per mile; this I propose to do, as it is in accordance with the evidence so far obtainable, though I am quite indifferent to the result, so far as the water scheme is concerned, because whatever increases the area to be filled increases the time within which satisfactory results might be anticipated, and *vice versa*.

The Artesian gradient of the Marlstone is not at present known, but considering that in the highly porous New Red Sandstone it amounts to 5ft. per mile, I think it cannot be less than 7½ft. per mile* (the dip of the beds eastward of Northampton), and therefore, so far as the dumb wells are concerned, there could be a head of water of 110ft. at Northampton before they would cease to act, or occasion loss.† The head of water at the Billing Road well when first made was 90ft., or 20ft. less than this. An addition might reasonably be made to the gradient for those dumb wells situated along the Nen Valley eastward of Northampton, because they would be actually more than a mile away from the town when only a mile from the line of strike.

It has been previously stated that coincidently with a rise in the water at the Northampton well of between 40ft. and

* Probably more than this if the material of the bed only were considered, but the prevalence of fissures may make it less in some directions.

† Height of Nen and river alluvium south of Billing Road pumping station, about 185ft. above sea-level. Height of Marlstone at Billing Road well, 75ft. Difference = 110ft. Artesian gradient counteracts dip of valley.

50ft., there was a small rise at the Berry Wood Asylum well, at Duston, three and a quarter miles away (see page 253). Both wells were being used at the time my information was obtained; the exact height of the former is indefinite, and the minimum height of the latter only known to me, hence I do not wish to attach too much importance to any calculations founded on them.* Take the rest-level of the water at the Billing Road well as being 40ft. above the Marlstone, and the rest-level at Duston as 9ft. above the same bed, and the Artesian gradient as $7\frac{1}{2}$ft. per mile, then the 40ft. of water at Northampton would sustain 40ft. $+ 3\frac{1}{4} \times 7\frac{1}{2}$ft. $= 64\frac{3}{8}$ft. at Duston, subtract the 9ft. of water there and we get about 55ft. as the increased height of the Rock-bed, and the dip would amount to a trifle over 17ft. per mile.

If this dip were maintained, and all other conditions remained the same as supposed, then a sector of a circle having a radius of twelve miles could be filled before the water would stand at the height of 110ft. at Northampton, as may be ascertained by a simple calculation. It is quite certain, however, that the dip increases as we get further away to the west or north-west, and equally certain that it is less than this northwards, so that I have based the following calculation on an area bounded by two radii at an angle of 125° with each other and an arc eight miles distant, in order to be well within the region of probability.

Area capable of being filled $= \pi r^2 \times \frac{125}{360} = 70$ square miles nearly.

One square mile of rock, 4ft. thick, would contain, at $\frac{2}{3}$ gallon per cubic foot, 74,342,400 gallons, and therefore the whole 70 square miles nearly 5,204 millions of gallons.

I do not say this is correct, but to show that it is reasonable, I would point out that for about forty years an average of something like 500,000 gallons per day has been pumped from the Marlstone, besides that lost by springs; this would amount to 7,300 millions of gallons, and reasoning on the assumed capacity of the Marlstone as given above, we will suppose that to get a "head" of 90ft., such as was obtained at first, 4,300 millions of gallons were already stored in the Marlstone, then 3,000 millions of gallons would have to be supplied by percolation during the period of forty years, this would amount to 75 millions of gallons per year, or 200,000 gallons per day. This the Marlstone seemed capable of yielding, but not much more, for when the Billing Road well

* Pumping was continued at Northampton for some time, after the rough estimate of 40 or 50 feet was given me, before I obtained the information about Duston well.

was supplying only about 315,000 gallons per day the amount was still declining, showing that the drain was then greater than the supply.

(To be continued.)

SOME INVESTIGATIONS INTO THE FUNCTION OF TANNIN IN THE VEGETABLE KINGDOM.

BY W. HILLHOUSE, M.A., F.L.S.

(Continued from page 276.)

In the following investigations I have in the main confined myself to a consideration of the "food-material" hypothesis of tannin. I have no evidence to offer as to the connection by Wigand* and Wiesner† of tannin with the colours of plants, and certain other points, too, which naturally suggest themselves, such as the relations of tannin with the vegetable acids, and the possibility that its ready oxidisability is of value to the plant, I have in no way investigated.

The question has been to me solely whether or not tannin must be looked upon as a member of the series of constructive materials, analogous to oil, sugar, and starch, a question which experimental evidence alone can answer. Deductive chemical biology can give no real assistance. The test by which it is determined that oil (in some forms), starch, and glucose, are materials out of which cellulose, &c., are formed must be here applied. If tannin be a constructive material, then, like starch and glucose, it will disappear through consumption; if it be not, it will be left behind. True, starch is in some cases not used up. I have found it in the old duramen of many trees (*e.g.*, *Cytisus Laburnum*), but here it remains, not because it is in itself useless, but because the plant forms more of it during the formative season than it has need of in the following spring.‡

* *Wigand*, l. c., Bot. Zeit., 1862.

† *Wiesner*, l. c., Bot. Zeit., 1862. Compare also Pfeffer, Pflanzenphysiologie, I., p. 306; and Nägeli and Schwendener, Das Mikroskop, p. 492.

‡ When leafing takes place normally in the spring, the new leaves begin to assimilate long before the limits of the reserve materials from the previous summer are reached; there is, therefore, a progressive accumulation of starch in the stem, especially in the wood parenchyma. If, on the other hand, from any cause the leaves first unfolded are killed or injured, the unused residue of the food-material is used to enable the axis to extend, and the plant to put out new leaves. This is the probable explanation of the difficulty I have experienced in exhausting branches of trees. When local supplies are exhausted they can still draw from unused stores below.

It will be seen from the foregoing abstracts that there is a radical divergence of opinion upon this point. Sachs, and with him Schröder,* have observed no consumption of tannin in the plants investigated by them; Dulk† found by quantitative analysis an increase of tannin in the autumn emptying of the leaves of the beech. On the other hand Wigand, Schell, and Th. Hartig state explicitly that they have in many cases seen a decrease or consumption of tannin in the processes of growth. The point is one, therefore, of conflicting evidence on a matter of considerable physiological importance.

My investigations have been conducted upon the following lines:—

1. To determine whether, as Wigand says, as the period of winter rest approaches, the quantity of tannin in stems diminishes *pari-passu* with the increase in the quantity of starch, so that the quantity of tannin is in winter at its minimum.

2. Whether, as Wigand further declares, in spring the quantity of tannin increases as that of starch decreases; or, as Hartig asserts, in the oak there exists a "Gerbmehl" which is dissolved and used up in spring.

3. Whether, as Schell believes, in germination and in stems in spring tannin is used up when the quantity of starch or other carbohydrate has reached a low point.

Firstly, to take the contention of Hartig.

In *Quercus pedunculata*, according to Hartig,‡ the stems contain "Gerbmehl." Nägeli§ had investigated this point, and found that Hartig's Gerbmehl is starch saturated with tannin, and, hence, taking the iron reactions. He tested it by saturating potato-starch with dilute solution of tannin, and found that the grains then gave the tannin reaction. Hartig, however, does not accept this explanation, for, as already noted, in 1878 he says that his opinion "ist von Seite anderer Physiologen einer Prüfung bis jetzt nicht unterzogen worden, und die von einer Seite erhobene Einwendung, dass das Gerbmehlkorn von flüssigen Gerbstoff durchdrungenes Stärkemehl 'sein könne,' eine durchaus willkührliche, gegenüber dem von mir geführten Nachweise, dass in den Gerbmehl

* *Schröder*, Versuchsstat., 1871, Bd. 14, p. 118.

† *Dulk*, ibid., 1875, Bd. 17, p. 192; see Pfeffer, Pflanzenphys., I., p. 305.

‡ *Hartig.* See also Anat. u. Phys. der Holzpflanzen, Taf. I.

§ *Nägeli.* See Nägeli u. Schwendener, Das Mikroskop, 2te Auflage, p. 492.

bildenden Zellen bis zum frühesten Zustande derselben aufwärts, die Körner in kaltem Wasser ohne Quellungserscheinungen leicht löslich sind, und von Eisensalzlosüngen schwarz, zugleich aber auch durch Jodlösung wie Stärke blau gefärbt werden." (l. c., p. 119).

Quercus pedunculata I have carefully examined at different periods through the late autumn, winter, and succeeding spring and summer. Throughout the winter the distribution of the tannin is as follows (*e.g.*, in a three year old stem):—In cortex, in large numbers of cells, each with a large mass of tannin (*i.e.*, diffused); bast, with small amount; bast rays, every cell filled with a granular, turbid-looking mass; wood ray cells, with abundant tannin, as have also many of the cells of the pith-crown, and fewer of the inner pith-cells.

Investigation at the same time of the contents of the stem by means of iodine reagents, and particularly by chlorzinc iodine, shows the following distribution of starch:—Cortical tissue and bast very little; bast rays none, or only a trace; wood rays quite full, commencing abruptly at the cambium layer (the starch in these cells stains at first very light reddish violet alike with iodine and with chlorzinc iodine). Wood fibres of all years in parts densely crowded, not only in the elongated wood-cells, with straight or oblique partitions, but also in many of the true libriform fibres with fusiform overlapping ends, and this especially the case in the innermost ring of wood; pith-crown cells full, as also many cells of the inner pith.

The use of chlorzinc iodine shows that in the coloration of the starch of the wood there is a large amount of red, overcoming in parts the blue; the whole contents of the soft bast show also a reddish tinge. The medullary rays I have already referred to; the starch in many of the pith-crown cells stains at first reddish with a voilet tinge, and where a grain from these is accidentally isolated it can be seen to be often of a pure magenta-red, or with a brownish tinge. In some cells often are grains which are red and others blue. In some cells all grains have a blood-red colour, in other cells all are more or less violet.

Iron salts showed in many isolated pith-crown cells, and in most of the wood-ray cells, grains, like in size and form to starch grains, but coloured of a cloudy blue tint. Sections placed in oil, after the fashion of Hartig, showed the same granules, no more and no less, and with the same reactions.

Repeated and careful examination showed that in no case did this so-called Gerbmehl of Hartig occur, except where the same cells and the same granules also responded, by a reddish coloration, to the action of iodine reagents.

The use of these and other reagents showed, therefore, that we had here granules which—

(*a*) Stain reddish, and subsequently bluish, with iodine reagents, and are therefore starch ;

(*b*) Stain bluish with iron salts, black with osmic acid, form brown balls with potassium bichromate, and are therefore tannin.

In other words they show that these grains are at the same time starch and tannin.

Through preparations which were treated with an iron-salt I passed for an hour or more, under the microscope, a current of water. This removed from cut cells the light iron tannin precipitate, but left the grains still coloured, but more lightly so, with the reagent. Each grain was distinctly bluish, but in no case did any grain which was so coloured dissolve.

Next I treated sections, with which I had not used any reagents, with a stream of water. No solution of grains was observable. The use of iron salts showed that from the cut cells a considerable quantity of tannin had been removed, readily identifiable in the water, but that in no case, so far as I could tell, had any granules been dissolved, and many of the grains in the cut cells showed as before a blue coloration with ferric salts.

In order to try whether by their differing solubility it is possible to separate tannin from glucose, I had had sections of this same plant in absolute alcohol for about three weeks. The tannin I had found to be not yet nearly dissolved out. Some of these sections, and others which had lain for a few hours in water, I tested with reagents. I found in no case a diminution in the number of the granule-containing cells, but I found that in the sections from water the granules no longer showed the tannin reaction, or only very feebly, while in the alcohol preparations some showed it slightly. These latter granules were in the same preparations treated with iodine, and showed themselves to be starch.

These experiments I controlled by others when *Q. pedunculata* was coming into leaf in late spring, and by yet others in summer. The granules (starch) had disappeared, but the tannin contents of the cells were still there, but in a fluid and not in a granular state.

With arrowroot starch soaked in a solution of tannin, I have followed out all the reactions. The results practically are the same. Starch grains saturated with tannin take the tannin reaction, the strength of the reaction depending on the strength of the tannin solution in which they had lain. That this was not due to a film of tannin in the grain I showed by rapidly washing grains in alcohol, when the grain still gave the tannin reaction; and the use of iodine on similar grains showed the tendency to the same red coloration, which I have noted in starch-containing cells of *Quercus*.

Hartig's " Gerbmehl " is, therefore, starch, into the intermolecular reticulum of which the solution of tannin in which they were lying had penetrated.

Some further light may be thrown on this by the case of *Acer Pseudoplatanus*. In the cells of the pith-crown I observed (October 22nd), in several specimens, the starch grains, after the action of iron chloride, surrounded by a cloudy blue coating. In the same species, on December 20th, the phenomena presented by *Quercus pedunculata* were substantially repeated in a large number of cells in the median portion of the pith-crown, where fluid tannin was earlier, and was then, most abundant. The same phenomenon was observed, though not followed out, in *Populus angulata*. Its distinctness in *Quercus* is probably due to the large quantity of tannin present.

(To be continued.)

THE PRINCIPLES OF BIOLOGY.*

BY HERBERT SPENCER.

Exposition of Chapters IX., X., and XI.

Coincidence between High Nutrition and Genesis.
Specialities of these Relations.

Interpretation and Qualification.

(Abstract.)

BY W. R. HUGHES, F.L.S.

Mr. Herbert Spencer reminds us in the opening chapter (IX.) that we have seen " that after individual growth, development, and daily consumption have been provided for, the surplus nutriment measures the rate of multiplication. This surplus may be raised in amount by such changes in the

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environment as bring a larger supply of the materials or forces on which both parental life and the lives of offspring depend. Be there, or be there not, any expenditure, a higher nutrition will make possible a greater propagation. We may expect this to hold both of agamogenesis and of gamogenesis; and we shall find that it does so."

The following illustrations, which are given mostly in Mr. Spencer's own words, will be appreciated by every naturalist.

"On multi-axial plants, the primary effect of surplus nutriment is a production of large and numerous leaf-shoots. How this asexual multiplication results from excessive nutrition is well shown when the leading axis, or a chief branch, is broken off towards its extremity. The axillary buds below the breakage quickly swell and burst into lateral shoots, which often put forth secondary shoots: two generations of organic individuals arise where there probably would have been none but for the local abundance of sap, no longer drawn off."

"No less conclusive is the evidence furnished by agamogenesis in animals." Sir John Dalyell, speaking of *Hydra tuba*, on which he had made some original observations, remarked: — "It is singular how much propagation is promoted by abundant sustenance. This polype goes on budding-out young polypes from its sides with a rapidity proportionate to the supply of materials." * * *

It is further shown that "the sexual multiplication of organisms under changed conditions, undergoes variations conforming to a parallel law. Cultivated plants and domesticated animals yield us proof of this."

Omitting for the sake of brevity the illustrations as to plants, those of animals are given, more particularly as to Birds and Mammals. In birds, "let us first contrast the farm-yard *Gallinaceæ* with their kindred of the fields and woods. Notwithstanding their greater size, which, other things equal, should be accompanied by smaller fertility, the domesticated kinds have more numerous offspring than the wild kinds. A turkey has twelve in a brood, while a pheasant has from six to ten. Twice or thrice in a season a hen rears as many chickens as a partridge rears once in a season." "Anserine birds show us parallel differences." Tame geese and ducks not only lay a larger number of eggs, and rear more young than wild ones, but the eggs are of larger size. So with pigeons. Every experienced poultry-keeper knows that to secure a good supply of eggs his fowls must be kept well fed and well housed. The same holds good as to rearing

chickens. "Equally clear proof that abundant nutriment raises the rate of multiplication, occurs among Mammals." Comparisons of the litters of the dog with those of the wolf and fox are shown to be considerably in favour of the dog. So with the wild and tame cats. So with the stoat and ferret. "Perhaps the most striking contrast is between the wild and tame varieties of the pig." While the one produces according to its age from four to ten young ones once a year, the other produces sometimes seventeen in a litter, or will bring up five litters of ten each in two years—"a rate of reproduction that is unparalelled in animals of as large a size, and it is specially noted "that this excessive fertility occurs where there is the greatest inactivity—where there is plenty to eat and nothing to do." * * *
The remainder of the chapter is devoted to meeting an objection :—"Many facts may be brought to prove that fatness is not accompanied by fertility, but by barrenness; and the inference drawn is that high feeding is unfavourable to genesis. The premiss may be admitted, while the conclusion is denied." * * *

The following chapter (X.) shows (1) that "if certain organisms are so circumstanced that highly nutritive matter is supplied to them without stint, and they have nothing to do but absorb it, we may infer that their powers of propagation will be enormous. If there are classes of creatures that expend very little for self-support in comparison with allied creatures, a relatively extreme prolificness may be expected of them. (2) Or if, again, we find species presenting the peculiarity that, while some of their individuals have much to do and little to eat, others of their individuals have much to eat and little to do, we may look for great fertility in these last, and comparative infertility, or barrenness, in the first." The numerous illustrations which follow amply verify these anticipations. A few only are selected :—(1) Parasitic plants like the *Rafflesiaceæ*, which live on the juices they absorb from other plants, have their organs for self-support only rudimentary because needless, but the organs devoted to reproduction, and distribution of germs, constitute the mass. *Fungi*, which grow on living plants, have the spore-producing parts relatively enormous. Parasitic animals, both in the *Epizoa* and *Entozoa*, afford similar illustrations, especially so in the nematoid *Entozoa*, where the mature female of *Ascaris lumbricoides*, living in the body of its host, and surrounded by nutriment, contains, according to Eschricht, as many as 64,000,000 ova, and even this remarkable number is exceeded among the cestoid *Entozoa*. The phenomena of pseudoparthenogenesis and metagenesis in insects, as occurring in the *Aphides*, are similarly accounted for by the fact "that they get plenty of easily assimilated food without exertion." (2) The remaining portion of the chapter answers the anticipation set forth at the beginning, and *inter alia* points out that "the physiological lesson taught us by bees and ants, not quite harmonising with the moral lesson they are supposed to teach, is that highly-fed idleness is favourable to fertility, and that excessive industry has barrenness for its concomitant." Illustrations will be familiar to most of us. * * *

The last chapter of this series (XI.) commences with the inference that, "considering the difficulties of inductive verification, we have (thinks Mr. Spencer) as clear a correspondence between the *à priori* and *à posteriori* conclusions as can be expected." It is pointed out that "the many factors co-operating to the result in every case, are so variable in their absolute and relative amounts, that we can rarely disentangle the effect of each one; and have usually to be content with qualified inferences." Though in the mass, organisms show a relation between great size and small fertility, yet special comparisons among them are to an extent vitiated by differences of structure, nutrition, and expenditure. But, says Mr. Spencer, "the broad fact is that organisms in which the integration and differentiation of matter and motion have been carried furthest are those in which the rate of multiplication has fallen lowest." * * * "How is the ratio between Individuation and Genesis established in each case?" Many detailed illustrations follow, showing that "all specialities of the reproductive process are due to the natural selection of favourable variations, and obviously, too, that a survival of the fittest has a share in determining the proportion between the amount of matter that goes to Individuation and the amount that goes to Genesis." * * * A qualification has to be made. It is pointed out that "each increment of evolution entails a decrement of reproduction that is not accurately proportionate, but somewhat less than proportionate." It must always be borne in mind that "each advance in evolution implies an economy." * * * Most interesting illustrations are traced as giving a solution of various minor anomalies "by which the inverse variation of Individuation and Genesis is obscured." A comparison between the blackbird and linnet, both of which usually lay five eggs and have two broods in a year. Yet the blackbird is far the larger of the two, and ought, according to the general law, to be much less prolific. Why is it not? The blackbird is omnivorous—the linnet graminivorous.

The feeble linnet is continually flying about to pick up his spare vegetal diet, thus involving much expenditure. The superior strength and intelligence of the blackbird enables it to procure a better and more varied diet—grain, fruit, worms, snails, beetles, larvæ. "The result is that the blackbird is ready to breed very early in spring, and is able during the summer to rear a second, and sometimes even a third brood." A comparison illustrating the same principle is instituted between the rat and the mouse. Both are equally prolific, although they differ greatly in size. But the rat, by its greater power, intelligence and cunning, is enabled to get a far larger and varied supply of nourishment than the mouse, which is mainly a vegetal feeder, without involving extra expenditure; "and this relative excess of nourishment makes possible a large size without a smaller rate of multiplication." The same principle is further evidenced by the contrast between the common rat and the water-rat. The common rat has several broods of as many as twelve each in a year, while the water-rat, a vegetal feeder, though somewhat smaller, has no more than six in a brood, and only one or two broods in a year. The difference between them, as in previous cases, is therefore mainly owing to the character of their food.

It is thus demonstrated that the inverse "variation of Individuation and Genesis is, therefore, but approximate." and the general law is seen that "Genesis decreases not quite so fast as Individuation increases."

Before approaching the final chapters in this grand work, on the "Multiplication of the human race," and on "Human population in the future," which are of the most vital importance and interest, Mr. Spencer sums up the preceding evidence in these words:—"Hence every type that is best adapted to its conditions, which on the average means every higher type, has a rate of multiplication that insures a tendency to predominate. Survival of the fittest, acting alone, is ever replacing inferior species by superior species. But beyond the longer survival, and therefore greater chance of leaving offspring, which superiority gives, we see here another way in which the spread of the superior is insured. Though the more-evolved organism is the less fertile absolutely, it is the more fertile relatively."

Reports of Societies.

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY.—Sociological Section. Tuesday, October 25th. At this the first meeting of the section for the session, the President, Mr. W. R. Hughes, F.L.S., delivered a brief address on "The Progress of the

Doctrine of Evolution," as evidenced by the literature that had appeared on the subject since the corresponding meeting last year. He said it was most gratifying to report that the name and influence of Mr. Herbert Spencer had penetrated into popular channels (some of them) the least anticipated. For instance, sketches of his system of philosophy (with portraits) had recently appeared in "Great Thoughts," and in the "Illustrated London News." There was also a reference to him in the Christmas Number of "Truth" for 1886, and a most appreciatory notice in the article, "Our Noble Selves," in the "Fortnightly Review" of February last. In the "Record of Ellen Watson" (3rd Ed., Macmillan and Co., 1886), that accomplished lady who died prematurely at the Cape, an extract of a letter to a friend (speaking of Mr. Spencer's "Education") states: "The great pleasure one has in reading anything of Spencer's springs from the breadth of the view he opens out before you. He lays the universe under continual contribution, and in discussing the least significant point keeps you awake to its connection with the whole of life." In "A Look Round Literature," by Robert Buchanan (Ward and Downey, 1887), this distinguished poet, novelist, and dramatist, says: "His (Mr. Spencer's) width of view, his catholicity of sympathy, his fearlessness in investigation, his faculty of crystalline exposition, seem to me almost superhuman." And again: "He closes no one gate of the universe, but leaves all wide open while we stand awe-stricken at the dazzling vistas which open out beyond them all." A most valuable and sympathetic exposition of Mr. Spencer's "Theory of Religion and Morality" had been written by Mr. Sylvan Drey, of Baltimore, and published by Messrs. Williams and Norgate (1887), as an essay, which should be in the hands of all Spencerians. In the magnificent work published by Messrs. Smith, Elder, and Co. (1887), in two volumes, entitled "The Reign of Queen Victoria: a Record of Fifty Years of Progress," and which contained contributions by some of the most eminent men of the day in literature, science, and art, the article on "Science" being by Professor Huxley, and "Literature" by Dr. Richard Garnett, of the British Museum, the latter states that "His (Mr. Spencer's) 'First Principles' (1862), the first number of a philosophical series, designed to be all-embracing, is the most characteristic bequest of the Victorian age to posterity;" and again: "In ethics, as in psychology and sociology, Mr. Spencer is our only great systematic writer." Finally, Mr. Hughes alluded to the remarkable sermon preached at St. Margaret's Church, Westminster, by the Bishop of Ripon, in May last, before the House of Commons, on the occasion of Her Majesty's Jubilee, in which he ranked "The Doctrine of Evolution," as formulated by Mr. Spencer, equal in point of importance to Newton's Law of Motion. Mr. Hughes said there were two local subjects that called for special notice—the departure of Miss Naden from Birmingham, and the publication of a most meritorious poem by the first Honorary Secretary of the Section, Mr. Alfred Hayes, B.A. With regard to the former, the loss which the Section and the Society had sustained was irreparable. Miss Naden's admirable scientific training added to her rare gifts as a poetess had enabled her to thoroughly grasp and appreciate the Synthetic Philosophy. The two addresses delivered by that lady before the Section, dealing with very intricate questions arising out of the Doctrine of Evolution, were monuments of her genius. Her recent beautiful volume of poems, "A Modern Apostle, &c." (Kegan, Paul, and Co., 1887), was thoroughly in harmony with that great doctrine. Birmingham had sustained a severe loss by her removal, and we could only wish her success and happiness in her future career. It was most satisfactory to note in connection with the publication of Mr. Hayes' beautiful volume, "The Last Crusade"

(Cornish Bros., 1887), that he had caught the spirit of the master. The following powerful lines from the poem indicated a thorough sympathy with the Doctrine of Evolution :

"Yet take heart ;
"For the eternal power who sowed the seed
"Of all things, hath ordained that hate shall tire,
"And love grow ever stronger."

It was gratifying to record that efforts were being made, as had been previously announced to the Section, to establish societies for the study of Mr. Spencer's system of philosophy, both in Derby and Paris. We wished Mr. L. Archbutt, in the former, and Mons. James Grosclande, C.E., in the latter city, every success. The only cloud that at present hung over his admirers was the sad state of Mr. Spencer's health, which prevented him from pursuing the object of his life —the completion of the synthetic philosophy. All his friends would cordially concur with the members of the section in sincerely wishing him improved health and strength. His was a most precious life, and one that we all earnestly hoped might be prolonged.—Thursday, November 3rd. Tea was served in the Society's room at 5 30, and at the meeting afterwards, the chair being taken by the President, Mr. W. R. Hughes, F.L.S., the first part of a paper on Mr. Herbert Spencer's essay on the Classification of the Sciences, was read by Mr. F. J. Cullis. After showing the impossibility of arranging the sciences in one lineal series, an explanation was given of Mr. Spencer's primary grouping of the sciences under the three denominations of "Abstract Sciences," "Abstract Concrete Sciences," and "Concrete Sciences." The "Abstract Sciences," Mathematics and Logic, were seen to deal with relations ; the "Abstract Concrete Sciences," Mechanics, Physics, and Chemistry, with properties, and the "Concrete Sciences," Astronomy, Geology, Biology, Psychology and Sociology, with aggregates. Leaving the "Abstract Sciences" as farthest removed from the special work of the Section, it was seen that a fundamental difference again appears in the fact that the "Abstract Concrete Sciences" are essentially analytical ; while the "Concrete Sciences" are mainly synthetical. It was further argued that this great group of sciences thus distinctly differentiated—both by their object, the study of phenomena in their totalities, and also by their method of comparison, classification, and synthesis—is most fitly denominated Natural History ; and thus these "Concrete Sciences" both constitute and limit the special sphere for the work of a Natural History Society.—Biological Section. Meeting, November 8.—Mr. R. W. Chase in the chair. On the motion of Prof. Hillhouse, President of the Society, seconded by Mr. R. W. Chase, President of the Section, the meeting of the Section was adjourned, with a resolution expressive of the great loss the Society, the Biological Section in particular, had sustained in the death, on the previous day, of Mr. Thomas Bolton, F.R.M.S., curator of the Society, and conveying the earnest sympathy of the meeting to his widow and family.—Geological Section. Meeting, November 15.—Mr. W. P. Marshall, M.I.C.E., took the chair in the unavoidable absence of Mr. Waller. A paper by Mr. William Pumphrey on "The recent Disaster at Lake Zug," was read by his brother, Mr. Chas. Pumphrey. The paper was illustrated by a photograph and ground plan. Exhibits :—Mr. W. H. Wilkinson, (1) Dried flowers showing the colours (eight or nine colours, including blue) successfully preserved; (2) Double autumn crocus, *Colchicum autumnale*. Mr. W. B. Grove, (1) *Agaricus phalloides* from Coleshill Pool; (2) *Polyporus radiatus* on alder from Sutton.—Sociological Section. Thursday, November 17th.—Mr. W. R. Hughes, F.L.S., in the chair. After tea, which was served at 5 30, the concluding portion of the paper on Mr. Spencer's essay on the Classification of the Sciences, was read by Mr. F. J. Cullis. It having been shown at the preceding meeting that Natural History includes and is constituted by the "Concrete Sciences,"—Astronomy, Geology, Biology, Psychology and Sociology; it was taken as a matter for congratulation that this Society has recognized and provided for a completely comprehensive scheme of Natural History. While probably the first Natural History Society to include Sociology within its sphere, it was certain that *of* this it will one day be proud; and *in* this it must necessarily be followed by Natural History Societies generally.

BIRMINGHAM MICROSCOPISTS' AND NATURALISTS' UNION.—October 17th. Mr. C. F. Beale exhibited a stone celt from New South Wales; Mr. J. Madison, specimens of *Planorbis complanatus* var. *rhombea*, from Coleshill; Mr. W. H. Bath, a dragon fly, *Libellula quadrimaculata*, from Waterford; Mr. A. T. Evans, peaty matter from an old bed thirteen feet from the surface, exposed in trial holes at Small Heath; Mr. H. Hawkes, under the microscope, *Peziza coronata*, and a series of slides of the same genus. Mr. J. Betteridge presented to the Society a collection of twenty birds of the district prepared for the cabinet, including specimens of the night jar, hawfinch, curlew sandpiper, dunlin, little grebe, and black tern.—October 24th. Mr. H. Hawkes exhibited a collection of fungi, including specimens of *Agaricus procerus* and *Boletus badius*; Mr. Deakin, part of skeletons of birds showing modifications of the sternum, clavicle and scapula; Mr. W. H. Bath, stag beetles, *Lucanus cervus*; Mr. Corbet, a cluster of amethysts, from Rowley Regis. Under the microscope, Mr. J. W. Neville showed palate of *Fusus islandicus*; Mr. Hawkes, *Phacidium ilicis*, and the secondary stage of the same fungus; Mr. J. Collins, flower of *Trifolium arvense*; Mr. Hutchinson, *Protococcus pluvialis*.—October 31st. Mr. H. Hawkes showed specimens of *Peziza aurantia* and *Puccinia graminis*; Mr. J. Madison, unusually large specimens of *Helix rupestris*, from Edge Hill; Mr. A. Bennett, jaws of young shark, and saw of sawfish. Under the microscope, Mr. Hawkes showed a fungus, *Botryosporium pulchrum*.—ANNUAL MEETING. The annual meeting of the Society was held on November 7th. The Treasurer's, Secretary's, and Curator's Reports were passed unanimously, the financial statement showing a balance in favour of the Society. The retiring President, Mr. J. Edmonds, delivered an address, in which he commended those careful and patient workers who loved Nature for her own sake, and who would leave a legacy of observation to future times. Such a Society should be a brotherhood in aim, without ostentation pursuing a useful course. The taste for natural science had been so great and pleasurable that he (the speaker) had tried to foster it in others. We must, however, remember that the pursuit of knowledge was not as simple and smooth as gliding down a glassy plane aided by grease and gravitation, but that Nature yielded up her treasures to the painstaking and importunate. The speaker urged the importance of making careful notes of all observations, and when practicable faithful drawings for future reference. The usefulness of photo-micrography, as an adjunct to science, was spoken of at some length, and recommended for the accuracy of its delineation and the simplicity with which a knowledge of the manipulation could be acquired. Mr. J. Edmonds proposed Mr. T. H. Waller, B.A., B.Sc., as president for the ensuing year; Mr. Dunn seconded the resolution, which was carried unanimously. After the usual votes of thanks were passed to the retiring President and other Officers of the Society, Mr. Oliver Hutchinson and Mr. John Collins were elected Vice-Presidents; Messrs. H. Insley and P. T. Deakin, Honorary Secretaries; Mr. W. Dunn, Treasurer; Mr. J. W. Neville, Sub-Editor; and Mr. J. A. Grew, Curator. Mr. John Betteridge was elected a life member in recognition of his kindness in presenting to the Society a collection of the birds of the district.